AS/YEAR 1 GLOSSARY

Achondroplasia **Genetic** condition caused by a **dominant allele**. Someone who is **heterozygous** for this condition has very restricted growth.

Acinar cell A cell from the **pancreas**. It produces **enzymes** that are used in digestion.

Acrosome, Acrosome reaction An **organelle** in the head of a **sperm** that contains digestive **enzymes**. When **fertilisation** takes place, the membrane surrounding these enzymes bursts. The enzymes digest the **follicle cells**; they also digest the jelly-like layer surrounding the **egg cell** allowing the sperm to fuse with the egg membrane. This process is known as the **acrosome reaction**.

Actin A **protein** found in many cells. Actin plays an important part in muscle contraction. It is also thought to be involved in cell **cleavage**.

Activation energy Before a chemical reaction can take place, bonds must be broken. This requires energy. This activation energy is normally provided by heating the substances involved in the reaction. **Enzymes** reduce the amount of activation energy necessary, so reactions in living organisms can take place at relatively low temperatures.

Active site The part of an **enzyme** molecule into which a **substrate** molecule fits during a chemical reaction. It is like a pocket on the surface of the enzyme and it has a specific shape. Only a substrate molecule with the complementary shape will be able to fit into this active site.

Active transport A process that involves the movement of substances from where they are in a low concentration to where they are in a higher concentration; in other words, it involves the movement of substances against a concentration gradient. Active transport involves the use of specific **carrier proteins** in **cell membranes**. It also requires energy in the form of **ATP**.

Adaptation Any features of an organism that make it well suited to survive in its environment. Adaptations can be anatomical, physiological or behavioural.

Adaptive radiation The way in which a common ancestor may give rise to different **species**, each occupying a different ecological **niche**. For example, it is thought that all molluscs evolved from a worm-like ancestor. There are now many different species which are adapted to a wide range of niches. Present-day molluscs include slow-moving, land-dwelling **herbivores** such as slugs and snails, as well as rapid swimming **carnivores** like squid.

Adenine One of the **nucleotide bases** found in **nucleic acids**. When the two strands of nucleotides which make up a molecule of **DNA** come together, adenine always pairs with thymine. The atoms of the two bases are arranged in such a way that two hydrogen bonds form between them.

Adhesion A force resulting from attraction between molecules of different substances. In **xylem**, water molecules adhere to the molecules of **lignin** and to other substances which make up the walls of the vessel.

ADP, Adenosine diphosphate Adenosine diphosphate (ADP) is produced when a phosphate group is removed from **ATP**. Energy can be transferred from this reaction to do useful work in the cell.

Adrenaline A hormone produced by the adrenal glands at times of stress such as when we are angry or frightened. Scientists have shown that there are links between stress, adrenaline and an increased risk of heart disease.

Aerobic Aerobic means requiring the presence of oxygen. Aerobic **bacteria** are bacteria that can only live and multiply in the presence of oxygen. Aerobic respiration is **respiration** that requires the presence of oxygen.

Albinism **Genetic** condition caused by a **recessive allele** that results in the non-production of pigment.

Alga, Algal, Algae A group of plant-like organisms that include the one-celled organisms that form **phytoplankton** as well as the seaweeds. Although algae **photosynthesise** and their cells are surrounded by a **cell wall**, they are not plants. They belong to a group of organisms called the Protoctista.

Allele One of the different forms of a particular **gene**. In humans, a gene codes for the protein that transports chloride ions across the **cell surface membrane**. We all have this gene, the CF gene. The CF gene has two alternative forms or alleles. The normal allele, F, produces a functioning protein. The other allele, f, produces a protein which is very slightly different and does not function. If a person has two copies of the f allele, he or she will have **cystic fibrosis**.

Allergen A substance that produces an allergic reaction in a sensitive person. Many different substances can act as allergens. One concern

over the widespread use of **genetically modified** foods is that they may make allergens more widespread.

Alveolus, Alveoli One of the tiny air sacs in the lungs where gas exchange takes place. The alveoli are lined by a layer of cells known as **squamous epithelium**. These cells are very thin and this helps to ensure efficient **diffusion** of oxygen from the alveoli into the blood, and of carbon dioxide from the blood into the alveoli. The total surface area of all the alveoli in the lungs is very large. This large surface area also helps to ensure efficient diffusion.

Amino acid The basic unit or **monomer** from which **proteins** are formed. There are twenty different amino acids which may be linked by **condensation** to form proteins. All of these amino acids have the same basic chemical structure.

Amniocentesis A way of obtaining cells from a developing fetus. A developing fetus is wrapped in a membrane called the amnion. The space between the amnion and the fetus is filled with a fluid called amniotic fluid. Amniotic fluid contains some fetal cells. These cells can be examined and their **chromosomes** observed or the **DNA** that they contain may be investigated.

Amniotic fluid A developing fetus is wrapped in a membrane called the amnion. The space between the amnion and the fetus is filled with a fluid called amniotic fluid. This cushions and supports the delicate tissues of the developing fetus. Amniotic fluid contains some fetal cells. These cells can be examined and their **chromosomes** observed, or the **DNA** that they contain may be investigated.

Amphibian A member of the **class** of animals that includes frogs and toads. Amphibians have moist skin that acts as an additional gas exchange surface. They breed in water and produce aquatic larvae called tadpoles, which change into terrestrial adults.

Amylase An **enzyme** that digests starch into soluble sugars. This reaction involves the addition of water molecules so it is an example of **hydrolysis**. Amylases are important digestive enzymes in animals but they are also found in many **microorganisms** and plant tissues. Amylose is a polysaccharide. Amylase is the enzyme that breaks down amylose to maltose.

Amylopectin Amylopectin is a **polysaccharide** formed of branched chains of **glucose** molecules. **Starch** consists of a mixture of amylopectin and **amylose**.

Amyloplast An **organelle** found in plant cells which stores **starch**. Each amyloplast consists of a tiny grain of starch surrounded by a double-layered **cell membrane**.

Amylose Amylose is a **polysaccharide** formed from a long straight chain of **glucose** molecules. This chain winds into a spiral shape. **Starch** consists of a mixture of amylose and **amylopectin**.

Anabolic An anabolic reaction is a chemical reaction in which smaller molecules combine together to produce larger ones. Examples of anabolic reactions include **photosynthesis** and protein synthesis.

Anaemia A condition in which there is a reduced amount of **haemoglobin**, the oxygen-carrying pigment found in red blood cells. People suffering from anaemia tire easily and soon get out of breath if they exert themselves. There are several causes of anaemia. One of them involves a shortage of iron in the diet.

Anaerobic, Anaerobically Anaerobic means the absence of oxygen. Anaerobic **bacteria** are bacteria that only live and multiply in the absence of oxygen. Anaerobic respiration is **respiration** that takes place in the absence of oxygen.

Anaphase A stage in cell division in which **chromosomes** are pulled apart by the **spindle** fibres. One chromosome from each pair goes to each of the 'poles' of the cell.

Aneurysm A weakening of the wall of an artery, which results in a balloon-like swelling. The condition is obviously very serious but in some cases it is possible to repair the damaged artery surgically.

Angina Pain in the chest that occurs when the heart muscle does not receive enough oxygen-rich blood. During exercise heart muscle requires more oxygen because its rate of **respiration** is higher. If the **coronary** arteries cannot supply enough oxygenated blood, the heart muscle respires **anaerobically**. Lactic acid is produced and this causes the pain of angina.

Angiosperm An angiosperm is another name for a flowering plant. The angiosperms include a variety of plants such as daffodils, oak trees and grasses like wheat and rice. Most economically important plants are angiosperms. Angiosperms have reproductive organs, which are found in flowers. Angiosperms produce seeds, which are formed as a result of fertilisation. These seeds are enclosed within fruits.

Animalia The kingdom containing animals. Animals share the following characteristics. 1) They are multicellular eukaryotic organisms. They have different sorts of cells which are specialised to form different organs. 2) Their cells do not have cell walls or large vacuoles. 3) Their nutrition is heterotrophic and they are unable to photosynthesise. 4) Most animals can move from one place to another and these movements are coordinated by a nervous system.

Antenna, Antennae A pair of long, jointed structures found on the head of an animal such as an insect, a woodlouse or a lobster. Antennae have a sensory function and have sense organs that are sensitive to touch or enable the animal to detect the presence of particular substances.

Anterior The front or head end of an animal.

Antibiotic A term originally used to describe a substance produced by one type of **microorganism** that kills or stops the growth of another. Substances which have an antibiotic effect have now been found in a number of other organisms ranging from toads to snowdrops. Antibiotics are often modified chemically to make them more effective. These substances are not only important in medicine but are also used in helping to identify **genetically modified** organisms with a marker gene.

Antibody, Antibodies There are several different types of white blood cell. One of these is the **lymphocyte**. An antibody is a molecule produced by a lymphocyte when it encounters a particular **antigen**. For example, the virus that causes measles has antigens on its surface. If a person gets measles, these antigens cause the lymphocytes to produce measles antibodies. The antibodies help the person to overcome the infection and recover.

Anticodon A sequence of three **nucleotide bases** on a **transfer RNA** molecule, which is complementary to the corresponding **messenger RNA codon**. For example, CCA is one of the messenger RNA codons for the amino acid proline. The sequence of nucleotide bases from the corresponding anticodon is GGU.

Antigen A molecule of a substance that the body regards as foreign or harmful. The presence of a particular antigen causes **white blood cells** called **lymphocytes** to produce the corresponding **antibody**. For example, the virus which causes measles has antigens on its surface. If a person gets measles, these antigens cause the lymphocytes to produce measles antibodies. These antibodies help the person to overcome the infection and recover.

Antihypertensives Drugs to reduce high blood pressure (e.g. sympathetic nerve inhibitors).

Antioxidant Substance that protects against heart disease and other harmful conditions by protecting against damage caused by **radicals**.

Aorta The main **artery**. In a mammal, the aorta takes blood from the left **ventricle** of the heart. It bends over and goes down through the abdomen. Other arteries branch off from it and take blood to organs in the body such as the brain, the liver and the kidneys.

Apoptosis The process in which healthy animal cells die during the normal development of an organism. For example, there are millions of cells in the brain of a human **embryo**. During development apoptosis results in many of these cells dying even though they are quite healthy. The result of the death of these cells is the pattern of cells found in the adult brain.

Arabinose Arabinose is a **monosaccharide** with five carbon atoms in each of its molecules. It is one of the substances which help to bind together the **cellulose** molecules in plant **cell walls**.

Archaebacteria, Arachea Bacteria such as those that make use of sulfur and those which produce methane. They are sufficiently different from all other organisms that it has been suggested that they should be placed in a **kingdom** of their own, the Archaebacteria.

Arrhythmia The condition in which there is an irregular heart beat. Arrhythmias may result from heart disease but can occur without an obvious cause.

Arteriole, Arterioles A blood vessel which takes blood from the smaller **arteries** to the **capillaries**. Arteriole walls contain muscle fibres and there are rings of muscle fibre where they join the capillaries. By contraction of these muscle fibres, the blood supply to particular capillary networks is regulated to meet the needs of the part of the body concerned.

Artery, Arteries A blood vessel that takes blood from the heart to the **arterioles**, which lead to **capillaries**. In mammals, arteries usually contain blood rich in oxygen. There is one important exception to this. The pulmonary artery takes blood to the lungs. As this blood has come from the tissues it has a low concentration of oxygen.

Asexual reproduction, Asexually Reproduction by any means which does not involve the fusion of **gametes** or sex cells. Asexual reproduction occurs when a **bacterial** cell divides into two new cells. The growth of new plants from tubers and bulbs also involves asexual reproduction.

Atheroma, Atherosclerosis A disease of the **arteries**. The walls of an artery may be damaged by high blood pressure or a build-up of substances from cigarette smoke. As a result of this damage, cholesterol, calcium salts and fibrous tissue build up in the wall to form an **atheroma**. Atherosclerosis may cause more serious diseases of the circulatory system such as a heart attack or **myocardial infarction**.

ATP, Adenosine triphosphate Adenosine triphosphate (ATP) is an important molecule found in all living cells. It is involved in the transfer of energy. Most of the ATP in a cell is produced from **ADP** and phosphate using energy transferred during the process of **respiration**. When ATP is broken down, ADP and phosphate are produced and a small amount of energy is made available. This energy may be used: in active transport; to synthesise large molecules such as proteins from smaller ones such as amino acids; and for movement in cells such as sperm and muscle cells.

Atrioventricular node, AVN A small area of specialised tissue in the wall of the heart between the **atria** and the **ventricles**. It plays an important part in coordinating the heartbeat. The electrical impulse, which spreads over the surface of the atria from the **sinoatrial node**, is delayed briefly here before continuing to the ventricles. This ensures that the atria have emptied and ventricles have filled with blood before they start contracting.

Atrioventricular valve One of the valves between the **atria** and the **ventricles** in the heart. During the part of the **cardiac cycle** when the pressure of blood in the atria is higher than the pressure of blood in the ventricles, the valves open and allow blood into the ventricles. When the pressure of blood in the ventricles is higher than the pressure in the atria, the valves close. The atrioventricular valves ensure that blood can only flow through the heart in one direction. They prevent backflow.

Atrium, Atria One of the chambers of the heart that receives blood from the body. In the heart of a mammal, there are two atria. The left atrium receives blood from the lungs; the right atrium receives blood returning from the other organs of the body. The atria are separated from the **ventricles** by the **atrioventricular valves**.

Autolysis Self-destruction of cells.

Autonomy The ability to make decisions for oneself. A person acts autonomously when such decisions can be put into effect.

Bacteria, Bacterium Bacteria are **microorganisms**. They are economically very important. Not only do they cause many diseases but they also play a vital role in recycling chemical elements such as carbon, and they can be **genetically modified** to make a number of useful substances. Bacterial cells are **prokaryotic** cells. They do not have a **nucleus** or membrane-bound **organelles** such as **mitochondria**. Each cell is surrounded by a **cell wall** and is also very small in size.

Barr body, Barr bodies Each body cell in a female mammal contains two **X chromosomes**. Only one of these functions; the other is inactive. The inactive chromosome is coiled up tightly and forms a structure called a Barr body. If you look through a microscope at appropriately stained cheek cells from a human female you can see the Barr body as a small, densely stained spot just inside the **nuclear envelope**.

Basal metabolic rate, BMR The metabolic rate of a person who is completely at rest but not asleep. It is a measure of the energy required for activities that go on all the time. Examples are the beating of the heart, breathing, and the active transport of substances into and out of cells. Basal metabolic rate is usually measured in $kJ\ m^{-2}\ h^{-1}$. This takes into account the size of the person and the time, making it easier to compare figures.

Basement membrane **Epithelial cells** are cells which form the outer surface of many animals. They also line cavities inside organs. Epithelial cells sit on a membrane formed from **protein** fibres held in a jelly-like substance. This membrane is called a basement membrane.

Beta-galactosidase An **enzyme** that converts the **disaccharide lactose** into **glucose** and **galactose**. This reaction is an example of **hydrolysis**. Lactose is split into glucose and galactose by adding a molecule of water.

Bilayer Membranes within cells contain two layers of **phospholipids** and so are said to exist as bilayers.

Bile salts One of the components of bile, which is formed in the liver. Bile is secreted into the small intestine. Here, the bile salts make the digestion of **lipids** in the diet more efficient by breaking them down into tiny droplets. This increases the surface area on which lipid-digesting **enzymes** act.

Biodegradable The molecules of substances which are biodegradable can be broken down into smaller molecules and ions by **microorganisms** such as **bacteria** and **fungi**. Most paper and wood products are biodegradable but many plastics are not.

Biodiversity, Diversity The range of organisms found in a particular place. Deserts have a low biodiversity because the climate is harsh and few **species** are adapted to living in it: on the other hand, many different species are found in tropical forests and on coral reefs – these places have high biodiversities.

Biodiversity hotspot An area with a particularly high plant **biodiversity**.

Biofuels, Biofuel Fuels that are produced directly from living material or from the action of living organisms. Vegetable oil from sunflower seeds, ethanol formed by the **fermentation** of sugar cane waste, and methane produced from sewage are all examples of biofuels. Biofuels provide a renewable energy source and do not have a long-term effect on atmospheric carbon dioxide concentration.

Biological control The use of the natural **parasites** or predators of a pest to limit its numbers and reduce the amount of harm it does. An example of biological control is spraying maize plants with the bacterium *Bacillus thuringiensis* to kill caterpillars of the corn borer moth.

Biomass A term that describes the amount of living material present. Biomass is usually given in units such as g m^{-2} referring to both mass and the size of a sample.

Blastocyst When a **zygote** develops into an **embryo**, it first divides to form a hollow ball of cells. This hollow ball of cells is called a blastocyst.

Blood clot When a wound occurs, a **protein** in the blood called **fibrinogen** is converted to **fibrin**. Fibrin forms a mesh of protein fibres over the surface of the wound. This mesh traps red blood cells to form a blood clot. Blood clots may form inside arteries in people with **cardiovascular disease**. This may lead to the artery becoming blocked, a condition known as **thrombosis**.

Body mass index, BMI A figure used to describe a person's body mass relative to height. It is calculated from the formula: body mass index = body mass (kg) / height^2 (m). A person who has a body mass index under 20 is underweight, while a person whose body mass index is over 30 is classified as obese.

Bronchiole One of the small airways in the lung that goes from the larger **bronchi** to the **alveoli**.

Bronchus, Bronchi One of the large airways that take air into and out of the lungs. When a person breathes in, air enters through the nose and mouth and is then drawn down the **trachea**. The trachea splits into two main bronchi, one going to the right lung and one to the left. The main bronchi divide into smaller ones, and then into **bronchioles**.

Bundle of His Specialised fibres of heart muscle that go from the **atrioventricular node** to the tip of the **ventricles**. They rapidly carry the electrical impulse that controls the heartbeat to the tip of the ventricles. This means that when the ventricles start to contract, they squeeze the blood upwards and out through the **arteries** to the lungs and the rest of the body.

Callus In the **micropropagation** of plants, a single cell develops into a mass of cells called a callus. The callus cells are treated with **plant growth substances**; stems, leaves and roots then form. In this way new plants are produced.

Calorie Unit of energy. One calorie is the amount of energy required to raise the temperature of 1 g of water by 1 °C. One calorie equals approximately 4.18 joules. Kilocalories, 1000 calories, are sometimes called Calories with a capital letter.

Campylobacter Spiral-shaped bacteria that are one of the commonest causes of food poisoning. Symptoms of *Campylobacter* food poisoning generally last from three to five days and include headache, vomiting and diarrhoea.

Cancer A **tumour** or swelling resulting from the uncontrolled division of cells. These abnormal cells rapidly increase in number, invading and destroying the surrounding tissues. Individual tumour cells eventually break away from the original tumour. They are carried by the blood or the **lymphatic system** to other areas of the body where they form new tumours.

Capillary A very small blood vessel through whose walls substances are exchanged with the cells of the body. Capillaries are very small, between 5 and 20 micrometres (μm) in diameter, and have walls that consist of a single layer of very thin, flat cells.

Capsule Capsule is a term with different meanings. In some **bacteria**, a capsule is a layer which may be found outside the **cell wall**. In plants, a capsule is a type of **fruit**; when it is ripe, **seeds** are shaken out through small openings in its wall. The fruit of a poppy is a capsule.

Carbohydrate A substance containing the chemical elements carbon, hydrogen and oxygen. Carbohydrates get their name because the hydrogen and oxygen are always in the same proportion as they are in water – there are two atoms of hydrogen for every atom of oxygen.

Carbohydrates whose molecules are made up of a single unit are called **monosaccharides**. These units can be joined by **condensation** to produce **disaccharides** like **sucrose**, and **polysaccharides** such as **starch** and **cellulose**.

Carbon cycle The way in which the element carbon is cycled through an **ecosystem**. Carbon-containing compounds in plants are passed to herbivores and then to carnivores in food. Carbon dioxide is released from these carbon-containing compounds in the process of **respiration**. Carbon dioxide is taken up again by plants and converted back to carbon-containing compounds in **photosynthesis**. Processes such as the burning of **fossil fuels** affect the carbon cycle by increasing the concentration of carbon dioxide in the atmosphere. **Microorganisms** and **detritivores** have an important role in recycling carbon in dead material.

Carbon sink A stage in the **carbon cycle** in which carbon remains locked. Coal was formed from plants that grew in swampy conditions. When these plants died, they did not decay and the carbon they contained was not released as carbon dioxide. It remained locked up in the coal.

Carcinogen A substance which will cause cancer. Many organic substances, such as those found in the tar in cigarette smoke, are carcinogens. They damage **DNA**. Cells in which the DNA is damaged may become cancerous. This is more likely when there is an inherited tendency to develop cancer.

Cardiac cycle One complete cycle of the heart as it fills with and then pumps blood. During **systole**, cardiac muscle contracts and the heart pumps blood out through the **aorta** and **pulmonary** arteries. During **diastole**, cardiac muscle relaxes and the heart fills with blood.

Cardiac muscle Unlike skeletal muscle, cardiac muscle is involuntary, it is **myogenic** and it does not fatigue. Like skeletal muscle, its fibres are striated (have a striped appearance), however they are branched unlike skeletal muscle.

Cardiopulmonary A word meaning 'to do with the heart and lungs'.

Cardiovascular disease, Cardiovascular diseases, CVD A disease that affects the heart or blood vessels. Cardiovascular diseases are the main causes of death in the UK and account for about one in three deaths. The main forms of cardiovascular disease are **coronary heart disease** and **stroke**.

Carrier In **genetics**, a carrier individual is **heterozygous** and so carries (rather than manifests) the **recessive allele**.

Carrier protein A **protein** that binds with a specific ion or molecule and helps it cross a membrane.

Catabolic A catabolic reaction is a chemical reaction in which large molecules are broken down to produce smaller ones. Examples of catabolic reactions include many of those involved in respiration and digestion.

Catalyst A substance that increases the rate of a chemical reaction but remains unchanged at the end of the reaction.

Catheter A flexible tube which may be inserted into a narrow opening. Catheters are used in balloon angioplasty, a form of treatment that may be used in patients with severe **coronary heart disease**. A catheter is inserted into an **artery** in the groin and threaded into a blocked coronary artery. A tiny balloon at the tip of the catheter is then inflated, to help improve blood flow.

Causation, Causal link Causation means that a change in one variable results in a change in another variable. For example, during childhood there is a causal link between age and such variables as height, physical strength and vocabulary acquisition.

Cell The basic unit from which living organisms are built. A cell consists of a mass of **cytoplasm** surrounded by a **cell surface membrane**. Plants and animals are made up from many different types of cells, each of which is specialised for a particular function.

Cell cycle The well-organised pattern of events in which a cell that has just resulted from a cell division eventually itself divides to form new cells.

Cell membrane A membrane found either at the surface or inside a cell. Every cell in an animal or a plant is surrounded by a membrane, referred to as the **cell surface membrane** or **plasma membrane**. Cell **cytoplasm** also contains membranes, and **organelles** are surrounded by membranes. Cell membranes are very thin and consist mainly of a double layer of **phospholipid** molecules in which there are **proteins**.

Cell plate After the **nucleus** of a cell has divided by **mitosis**, the **cytoplasm** divides. In a plant cell, a thin layer forms in the cytoplasm between the nuclei. This is the cell plate. **Vesicles** formed by the **Golgi apparatus** bring substances to the

cell plate and it eventually develops into the new cross wall between two cells.

Cell surface membrane See **Cell membrane**.

Cell wall A rigid layer surrounding a cell. **Bacteria**, **fungi** and plant cells have cell walls. Animal cells do not. In plants, the most abundant substance in the wall is **cellulose**. The cell walls of bacteria and fungi do not contain cellulose. They are made of other substances.

Cellulase An **enzyme** that digests cellulose into soluble sugar; this reaction involves the addition of water molecules so it is an example of **hydrolysis**. Cellulase is produced by many different **microorganisms** but it is not produced by animals. An animal such as a cow can digest cellulose because it has large numbers of **bacteria** and other microorganisms in its gut. It is these microorganisms that produce the necessary cellulase enzymes.

Cellulose A **polysaccharide** which is an important component of plant **cell walls**. A molecule of cellulose consists of a long straight chain of beta-glucose molecules joined by **glycosidic bonds**. Hydrogen bonds form between neighbouring chains. These bonds hold the cellulose molecules together in bundles called **microfibrils**.

Centriole An organelle found in animal cells which is associated with the separation of chromosomes during mitosis. Biologists are not certain about the exact function of the centrioles, but they are associated with the protein fibres forming the **spindle**.

Centromere The region on a **chromosome** where two **chromatids** are held together during the early stages of cell division. The centromere is also the region to which the **spindle fibres** attach. The spindle fibres pull the chromatids apart during **anaphase**.

CFTR protein The channel **protein** whose malfunctioning causes cystic fibrosis.

Channel protein A **protein** that spans a membrane and is involved in the transport of molecules across the membrane.

Chiasma, Chiasmata The place where **chromosomes** can be seen to cross over each other in a cell undergoing **meiosis**. At the start of meiosis, pairs of **homologous chromosomes** come together, each chromosome consisting of two daughter **chromatids**. Chiasmata occur where these chromatids break and rejoin in the process known as **crossing over**. This involves rearranging genetic material and is an important source of genetic variation.

Chitin A nitrogen-containing **polysaccharide**. Chitin is found in the tough outer skeleton of insects and in the **cell walls** of **fungi**.

Chlorophyll The green pigment found in plants and other organisms which **photosynthesise**. It is responsible for the capture of light energy.

Chloroplast, Chloroplasts A **chlorophyll**-containing **organelle** found in the cells of plants and certain other organisms such as **algae**. **Photosynthesis**, the process in which light energy is converted to chemical energy, takes place inside chloroplasts.

Cholesterol A type of **lipid** which plays an important part in the body. It is an component of **cell membranes** and is a **precursor** which is converted into other important substances such as **bile salts**, and **steroid** hormones such as **testosterone** and **progesterone**. High concentrations of cholesterol in the blood are associated with **atheroma** and **cardiovascular disease**.

Chorionic, Chorion The chorion is one of the membranes that surround a developing fetus in the **uterus** of its mother. The chorion helps to form the **placenta**. It is folded and forms small finger-like projections. Each of these projections is called a chorionic villus.

Chorionic villus sampling Procedure in which a small sample of placental tissue (which includes cells of the fetus) is removed between 8 and 12 weeks of pregnancy and tested for **genetic** abnormalities.

Chromatid, Chromatids One of the two strands of genetic material that make up a **chromosome**. When chromosomes become apparent at the beginning of **mitosis**, each can be seen to consist of two strands of genetic material. Each of these strands is called a chromatid. During mitosis these chromatids are pulled apart and go to the opposite poles of the cell.

Chromatin The **DNA** in the **nucleus** of the cell when the cell is in **interphase**. At this stage in the **cell cycle**, **chromosomes** are not visible. The DNA in the nucleus is much more spread out. In this condition it is known as chromatin.

Chromosome, Chromosomes One of the thread-like structures in the **nucleus** into which **DNA** is organised. Only during cell division, when chromosomes become shorter and thicker, can they clearly be identified as distinct structures. A chromosome consists of DNA, a small amount of **RNA**, and various **proteins**, some of which are involved in packaging the DNA. In **bacteria**, the DNA forms a loop which is sometimes called a bacterial chromosome. It is not a true

chromosome because it does not contain packaging proteins.

Chromosome puff Some insect cells have very large **chromosomes** called **giant chromosomes**. These giant chromosomes are visible at all stages of the **cell cycle**. When a **gene** on these giant chromosomes is active, the part of the chromosome on which this gene is situated unravels and spreads out to form a chromosome puff.

Cilia, Ciliated, Cilium Tiny hair-like extensions (singular **cilium**) of the **cell surface membrane**. Ciliated **epithelial cells** line the airways of the lungs. Small particles of dust in the air we breathe in are trapped in the **mucus** that lines these airways. The beating action of the cilia continuously wafts this mucus and the trapped particles up into the throat where it is swallowed. Ciliated epithelial cells also waft egg cells down the **Fallopian tube** from the **ovary** to the **uterus**.

Class Biologists divide organisms into smaller and smaller groups that reflect their similarities and differences. All living organisms belong to one of five kingdoms. Each kingdom is then divided into a number of phyla. Each phylum is further broken down into a number of classes and so on. Humans belong to the **mammal** class and share features such as the possession of hair and sweat glands with all other mammals.

Cleavage The process of **mitosis** results in the formation of two nuclei which are genetically identical. After mitosis has taken place, the **cytoplasm** divides and two new cells are formed. We call the division of the cytoplasm cell cleavage.

Closed circulatory system The type of blood system found in larger animals such as humans, in which blood is enclosed in blood vessels. Blood flows from the heart in **arteries**. It then flows through **arterioles** to **capillaries**. It returns to the heart from the capillaries through **venules** and **veins**.

Cnidaria The group of animals that contains jellyfish, sea anemones and corals. Many cnidaria have specialised stinging cells with which they catch their prey.

Co-adaptation When two speceis are adapted so they come to depend on each other for their survival.

Codominant, Codominance A pair of **alleles** are said to be codominant if both are expressed in the **phenotype** of the **heterozygote**. In plants such as antirrhinums, flower colour is determined by a single **gene** with two alleles, **CR** and **CW**. The **homozygote CRCR** has red flowers. **CWCW** has white flowers. The heterozygote **CRCW** has pink flowers. As both alleles are expressed in the pink flowers, these alleles are referred to as being codominant.

Codon A sequence of three **nucleotide bases** on a **messenger RNA** molecule that codes for a particular **amino acid**. For example, the messenger RNA codon CCA codes for the amino acid proline.

Cohesion A force resulting from attraction between molecules of the same substance. Water molecules stick to each other by cohesion. As a result, **transpiration** pulls a continuous, unbroken water column up through the **xylem** in a plant stem.

Cohesion-tension A theory explaining the movement of water through the xylem of a plant from the roots to the leaves. Water molecules stick to each other by **cohesion**. As a result, **transpiration** pulls a continuous, unbroken water column up through the **xylem**. This water column is under tension as a result of being pulled up by transpiration and down by gravity.

Collagen A tough **fibrous protein** found in animals. Collagen is found in tendons and bones, and in the outer layers of **arteries** and **veins**.

Collenchyma A type of supporting tissue found in plants. Collenchyma cells are slightly elongated and have their **cell walls** strengthened with extra **cellulose** at the corners.

Columnar epithelium **Epithelial cells** are cells that form the outer surface of many animals. They also line cavities inside organs. Epithelial cells differ in shape. Columnar epithelial cells are, as their name suggests, tall and thin, and line the small intestine and the airways of the lungs.

Community All the living organisms – animals, plants and **microorganisms** – found in a particular place at a particular time. The community found on a coral reef, for example, consists of the corals themselves and the **algae** that live within their cells, together with all the other different species of animals – the fish and worms and crabs – as well as the **bacteria**.

Companion cell These long thin cells lie alongside phloem sieve tubes and perform the metabolic functions to maintain the sieve tube cells which lack cell organelles and only have a thin layer of cytoplasm around the edge of the cell.

Competition, Compete A relationship between different organisms which require the same resources. Competition occurs between different **species**. Weeds, for example, compete with crop

plants for resources such as water, mineral ions and light. Competition may also occur between organisms of the same species, such as when seedlings of a particular species of plant compete with each other when they are growing close together.

Complementary base pairing, Complementary The **nucleotide bases** in **nucleic acids** always pair in a particular way. **Adenine** always pairs with **thymine** in **DNA** and with **uracil** in **RNA**. **Cytosine** always pairs with **guanine**. Complementary base pairing allows exact copies of DNA to be made in **DNA replication**. **Transcription** and **translation** also rely on complementary base pairing.

Concentration gradient A concentration gradient occurs when a substance (e.g. oxygen) exists at a higher concentration in one place than another, with intermediate concentrations in between.

Condensation A type of chemical reaction in which small molecules are joined together with the removal of a molecule of water. Condensation is involved in forming biologically important **polymers**. The reactions in which **amino acids** join to form **proteins**, and **glucose** molecules join to form **starch** and **cellulose** are examples of condensation reactions.

Congenital disease A disease or condition that is present at birth. Congenital conditions may be inherited, like sickle cell anaemia or cystic fibrosis. They may also result from an environmental factor such as the effect of drugs or the consumption of too much alcohol by the mother during pregnancy, or the acquisition of a disease such as HIV.

Connective tissue **Tissue** that is found in animals and supports or binds together other tissues in the body. Connective tissue forms tendons, ligaments and bones. Blood is a specialised connective tissue.

Continuous variation Variation in which there is a complete range from one extreme to the other. Human height is an example of **continuous variation**. A person can be any height within the human range. Continuous variation often occurs when a character is controlled by many different **genes**, in other words, it is **polygenic**.

Convergent evolution Unrelated organisms which live in similar habits and occupy similar **niches** often look very similar. This is because they experience the same selection pressures. Dolphins are **mammals** and sharks are fish, but they both have the same streamlined shape. This is an adaptation for swimming rapidly and catching fish.

Coronary artery The heart muscle is supplied with blood through the two coronary arteries. If these become blocked due to **coronary heart disease**, this can lead to **myocardial infarction**.

Coronary heart disease, CHD Disease affecting the coronary **arteries**. These arteries supply blood to the heart muscle. If a branch of one of these arteries becomes narrow or blocked, the area of the heart muscle that it supplies no longer receives a supply of oxygen-rich blood. This is the cause of the chest pain known as **angina**. If a blood clot blocks the narrowed **coronary artery**, an area of cardiac muscle dies and this gives rise to a heart attack or **myocardial infarction**. A frequent cause of narrowing and blockages in the coronary arteries is **atherosclerosis**.

Correlation Two variables are said to show a correlation (to be correlated) if there is either a positive or a negative relationship between them.

Cotyledon, Cotyledons A leaf from an **embryo** plant inside a **seed**. In some plants, when seeds **germinate**, the cotyledons may stay below the surface of the soil and supply the developing plant with nutrients. In others, the cotyledons emerge from the soil, turn green and **photosynthesise**. The number of cotyledons present is one of the features used in classifying plants. **Monocotyledons** have one cotyledon and **dicotyledons** have two.

Counselling Technique to help someone make a decision for themselves by talking the possibilities through with someone else.

Cristae A feature of mitochondria. Mitochondria are **organelles** that have two **cell membrane** layers, an outer membrane and an inner membrane. The outer membrane is smooth and surrounds the mitochondrion. The inner membrane, however, is folded inwards to form a series of cristae. The cristae increase the membrane surface area. This is important because it is on this membrane that reactions involved in **respiration** take place.

Crossing over The process in which **chromatids** break and rejoin during meiosis. At the start of **meiosis**, pairs of **homologous chromosomes** come together, each **chromosome** consisting of two chromatids. Crossing over occurs between these chromatids. It involves rearranging genetic material and is an important source of genetic variation.

Cyclin A **protein** that helps to regulate and control the events of the **cell cycle**. The levels of

different cyclins in the cell rise and fall. It is these changes in concentration that control the cell's progression from one stage in the cell cycle to the next.

Cyclin-dependent kinase, CDK An **enzyme** that plays an important part in regulating and controlling the events of the **cell cycle**. The enzyme combines with proteins called cyclins. This leads to the activation of other proteins involved with such processes as the breakdown of the **nuclear envelope** and the formation of the **spindle**.

Cystic fibrosis, Cystic fibrosis transmembrane regulator An inherited condition in which a faulty gene results in the production of a faulty transport **protein** in **cell membranes**. The CFTR (cystic fibrosis transmembrane regulator) protein transports chloride ions across the membrane. A person with cystic fibrosis has a faulty CFTR protein, so produces thick, sticky mucus. This leads to problems with digestion and gas exchange.

Cytoplasm The cytoplasm is a jelly-like fluid surrounded by the **cell surface membrane**. Ions, sugars and amino acids are dissolved in cytoplasm, and large molecules are suspended. It also contains a network of **proteins**, which help to give the cell its shape. **Organelles** such as **mitochondria** are suspended in the cytoplasm.

Cytoplasmic division The stage after the end of **mitosis** in which the **cytoplasm** divides into two, allowing the two new nuclei to belong to distinct cells.

Cytosine One of the **nucleotide bases** found in **nucleic acids**. When the two strands of nucleotides which make up a molecule of **DNA** come together, cytosine always pairs with guanine. The atoms of these two bases are arranged in such a way that three hydrogen bonds form between them.

Decomposer A **microorganism** that lives by breaking down organic compounds in dead material and other waste products into carbon dioxide, water and mineral ions. Decomposers play a very important part in the cycling of chemical elements such as carbon.

Denature When a protein is denatured, the chemical bonds that maintain its **tertiary structure** are broken. As a result, the molecule loses its shape and is unable to function. High temperatures and changes in pH often lead to the denaturing of proteins. This explains the effect of high temperatures on the rate of enzyme-catalysed reactions.

Deoxyribose A five-carbon sugar. Deoxyribose is an important component of **DNA**. DNA is built up of **nucleotides**. Each nucleotide is formed from deoxyribose, a phosphate group, and a **nucleotide base** linked together by **condensation**.

Depolarisation During nervous conduction, or the contraction of the heart, the electrical charge inside the nerve cells, or heart muscle cells, briefly becomes positive relative to outside the cells. The cells are then said to be depolarised.

Detritivore An animal that feeds on dead remains. Soil organisms such as earthworms and woodlice are detritivores. Investigations have shown that **saprobionts** like **bacteria** and **fungi** break down dead material much faster if it has passed through the gut of a detritivore. Detritivores break up tough tissues. This exposes a greater surface area for the **enzymes** produced by the saprobionts to act upon.

Diaphragm A thin sheet of muscle situated between the lungs and the abdominal organs of a mammal. Contraction of this muscle causes the diaphragm to flatten and air to be drawn into the lungs.

Diastole, Diastolic The stage in the cardiac or heart cycle when the heart muscle relaxes. During this stage the heart is filling with blood.

Diastolic pressure The blood pressure during the phase of the **cardiac cycle** when the **ventricles** are contracting.

Dichotomous key In a dichotomous key, used, for example, to identify organisms, there are always two possible answers to each question about the features of the organism.

Dicotyledon, Dicot A member of the group of flowering plants which have two **cotyledons** in their **seeds**. Dicotyledons include plants such as buttercups, roses and oak trees. All dicotyledons have seeds in which the **embryo** has two cotyledons; flower parts such as petals arranged in fours or fives; and leaves with veins which spread out in a net-like arrangement.

Dietary fibre Indigestible **polysaccharides**. Dietary fibre is thought to be important in the prevention of such 'Western diseases' as coronary heart disease, diabetes and bowel cancer.

Differentiation, Differentiate We all started life as an undifferentiated single cell or **zygote**. As we grew and developed into adults, our cells became specialised for different purposes. The process by which cells become specialised is called differentiation. When plants are produced by **micropropagation**, unspecialised cells

differentiate to form the many types of cell in an adult plant.

Diffusion, Diffuse The movement of molecules from where they are in a high concentration to where they are in a lower concentration. Small molecules such as oxygen diffuse through **cell membranes** into cells. Other molecules cross cell membranes with the aid of **proteins**. This form of diffusion is called **facilitated diffusion**. **Osmosis** is a special form of diffusion involving water molecules.

Diffusion gradient **Diffusion** involves the movement of a substance from where it is in a high concentration to where it is in a lower concentration. The difference in concentration which allows diffusion to take place is sometimes referred to as a diffusion gradient. Oxygen diffuses into a cell down a diffusion gradient.

Digestion, Digest The process in which the large insoluble molecules which make up an organism's food are broken down by **enzymes** to smaller soluble molecules. Mammals such as humans have specialised guts. **Saprobionts** such as **bacteria** and **fungi** secrete enzymes over the surface of their food. They then absorb the soluble molecules of digested food through their outer surface.

Dipeptide A molecule that is made up of two **amino acids** joined by a **peptide bond**.

Diploid Cells or organisms in which the **nuclei** contain two copies of each **chromosome**. The diploid number of chromosomes differs from one **species** to another. In humans, the diploid number of chromosomes is 46. This is sometimes written as $2n = 46$.

Dipole A molecule with an unevenly distributed electrical charge, giving a positively charged and a negatively charged end of the molecule, also known as a **polar molecule**. For example, water is a dipole.

Disaccharide A **carbohydrate** that is made up of two sugar units or **monosaccharides**. **Maltose** is a disaccharide. It is made of two molecules of **glucose** joined by **condensation**. Other biologically important disaccharides are **sucrose** and **lactose**.

Discontinuous variation Variation in which individuals fall into distinct categories. In peas, for example, plants are either tall or short. There are no intermediates. Discontinuous variation results from the **genes** that an organism inherits. **Environment** has little or no effect.

Disinfectant A substance that kills **microorganisms** when they are outside the body. Because they kill **bacteria** they may be described as **bactericidal**. Some disinfectants, when used at low concentrations, can be used on the human body as antiseptics.

Dispersal, Disperse The way offspring of an organism are spread and reach new areas. The **seeds** and **fruits** of flowering plants, for example, have different adaptations which result in the plant being able to disperse and colonise new areas. This helps to reduce **competition** between the parent plant and its offspring.

DNA polymerase An **enzyme** that catalyses the joining together of individual **nucleotides** to form a molecule of **DNA**. DNA polymerase is essential to the process of **DNA replication**. It is also important in **gene** technology where it is used in the **polymerase chain reaction** (PCR) to produce a large number of identical copies of small pieces of DNA.

DNA, Deoxyribonucleic acid The molecule that forms the **genetic** material of all living organisms. Chemically, **DNA** consists of two polynucleotide chains forming a double helix. Each chain consists of a **sugar**-phosphate backbone. One of four **nucleotide bases** is attached to each sugar in this backbone. These bases are joined, **adenine** to **thymine** and cytosine to **guanine**, by **hydrogen bonds**. In an animal or plant cell, DNA is found in the **chromosomes** in the **nucleus**. There are also small amounts of DNA in the **mitochondria** and **chloroplasts**. Genes are sections of DNA that code for particular **proteins**.

DNA replication, Replication, Semi-conservative replication The process in which a molecule of **DNA** produces two exact copies of itself. The old DNA molecule unwinds and each of the chains acts as a template for the formation of a new chain. Each new DNA molecule therefore consists of one of the existing chains and one completely new one. This process is known as semi-conservative replication.

Dominant allele An **allele** is described as dominant if its effect is always shown. In peas, the allele for tall plants, T, is dominant to the allele for short plants, t. Because the allele for tall plants is dominant, plants with either the **genotype** TT or the genotype Tt will be tall.

Dominant organism A species that has an important effect on the other organisms in a **community**. In many British woods, for example, the dominant tree is oak. Its size determines such factors as how much light falls on the ground and the water content of the soil. These factors determine the other organisms able to grow in an oak wood.

Dormant, Dormancy A dormant **seed** is one that does not **germinate** and grow immediately, even if the environmental conditions are favourable.

Dorsal The back or upper surface of an animal or a structure associated with it. The dorsal fin of a shark, for example, is the fin on its back, which is visible when the shark is swimming at the surface.

Double-blind test A way of conducting a clinical trial on, for example, a new drug. Neither the patient nor the researcher conducting the trial knows who is having the drug and who is being treated with an inactive substance (placebo). This helps to make the results of the trial reliable.

Double circulation A type of blood system in which blood passes through the heart twice in its passage round the body. Mammals have a double circulation. Blood is pumped to the lungs from the right **ventricle** of the heart. It returns to the heart where it is pumped again, this time by the left ventricle. It now goes to the other organs of the body.

Duties Things each of us ought to do. For example, if you have a child, you have the duty to look after him/her.

Ecosystem An ecological term referring to all the organisms living in a particular area as well as the non-living features of their **environment**.

Ectotherm An animal such as a **reptile** whose temperature fluctuates with that of its **environment**. Many ectotherms, however, are able to keep their internal temperature within a narrow range by moving from one part of their environment to another. A marine iguana, for example, moves between water and land with the result that its internal temperature varies very little.

Effector A tissue or organ that responds to a nerve **impulse** or hormone. An effector brings about a response or a change. In a mammal, muscles and glands are examples of effectors. See also **receptor**.

Egg cell, Egg nucleus A haploid sex cell or gamete, produced by meiosis in female sex organs. Egg cells are found inside the **embryo sac** in the **ovary** of a flowering plant, and in the ovaries of a woman. An animal egg cell is also known as an **ovum**. The egg cell fuses with a male **gamete** to form a **zygote**. The zygote grows and divides by **mitosis** to form an **embryo**.

Electrocardiogram A graphic record of the electrical activity of the heart as it contracts and rests.

Embryo When a female **gamete** is fertilised, a **zygote** is formed. In animals and plants this zygote grows and divides by **mitosis**, eventually becoming a new adult. The term embryo is used to describe the early stages in development. The embryo of a flowering plant is found inside a **seed**. A mammalian embryo develops inside the **uterus** of its mother.

Embryo sac Part of the **ovary** of a flowering plant. The embryo sac contains a number of **nuclei**. One of these is the egg nucleus, sometimes called the **egg cell**. This fuses with a male **gamete** to form a **zygote**. The embryo sac also contains two **polar nuclei**. The polar nuclei fuse with a second male gamete to form a nucleus with three sets of **chromosomes**. This eventually develops into the **endosperm** which provides food for the developing embryo. The embryo sac is also called the ovule.

Embryonic stem cells **Stem cells** obtained from an **embryo**.

Endocrine A gland that secretes **hormones** directly into the blood is called an endocrine gland. Glands are organs which secrete particular substances. The **pancreas** is an endocrine gland because it secretes the hormone **insulin** into the blood. It is also an exocrine gland because it secretes digestive **enzymes** into a duct which takes them into the intestine.

Endocytosis A process which involves the transport of large particles or fluids into cells. The **cell surface membrane** surrounds the particles concerned. A **vesicle** is pinched off from the membrane and moves into the **cytoplasm** of the cell.

Endoplasmic reticulum System of flattened, membrane-bound sacs found in the **cytoplasm**. It plays a role in the synthesis and transport of molecules within the cell.

Endosperm During fertilisation in a flowering plant, one of the male **gametes** fuses with two of the **nuclei** in the embryo sac. The resulting nucleus has three sets of **chromosomes**. It divides rapidly and gives rise to the endosperm, a mass of large cells that acts as a food store for the developing **embryo** in the **seed**.

Endothelium A thin layer of cells that lines the inside surface of blood and lymph vessles

Endotherm An animal such as a **mammal** whose temperature changes very little whatever the temperature of its surroundings. Endotherms rely on physiological processes such as sweating and shivering to maintain their temperature.

Environment, Environmental The conditions of the external environment which affect an

organism can be divided into two groups. Abiotic factors are concerned with the non-living part of the environment; temperature and rainfall are abiotic factors. Biotic factors involve other organisms; **competition** is a biotic factor.

Enzyme Enzymes are **proteins** that speed up chemical reactions in living organisms. For instance, inside a typical cell many different reactions are taking place. Each of these is catalysed by a specific enzyme. Without these enzymes, the reactions would take place very slowly at the temperatures inside cells.

Enzyme–substrate complex, ES complex In a chemical reaction controlled by an **enzyme**, one or more **substrate** molecules fit into the **active site** of the enzyme to form an enzyme–substrate complex. The substrate molecules are held in such a way that a reaction takes place. Product molecules are produced and released while the enzyme is unchanged.

Epidermis The outer layer of cells in a multicellular organism. In plants, the epidermis is a single layer of cells surrounding the other tissues in the roots, stems and leaves.

Epithelium, Epithelial Tissue which forms the outer surface of many animals. Epithelial cells also line the cavities of organs such as the gut and lungs. The epithelium consists of one or more layers of cells sitting on a **basement membrane**. These cells may be flat (**squamous** or pavement epithelium) or tall in shape (**columnar epithelium**).

Equator At cell division, the widest part of the cell, mid-way between the poles.

Essential amino acid An **amino acid** that the body needs but is unable to make itself. Essential amino acids have to be present in the diet in amounts sufficient to meet the needs of the body.

Essential fatty acid A **fatty acid** that is essential for growth and which the body is unable to make. Linoleic acid is an example of an essential fatty acid. Because the human body is unable to make it, linoleic acid must be present in a person's diet.

Ester bond **Triglycerides** are formed from **glycerol** and **fatty acids** with a chemical bond between them called an ester bond. A **condensation** reaction removes a molecule of water each time a glycerol molecule combines with a fatty acid.

Ethics Reasoned views about why certain things are wrong and others right. There is no single ethical framework on which everyone agrees. However, four widely used ethical frameworks use the principles of **rights** and **duties**, **utilitarianism**, **autonomy** and **virtue**.

Eugenics Use of selective inheritance to attempt to improve the human race.

Eukaryote, Eukaryotic An organism that has cells containing a **nucleus**. Eukaryotic cells also contain organelles such as **chloroplasts** and **mitochondria,** which are surrounded by membranes. Animals and plants are eukaryotes; **bacteria** are prokaryotes. Prokaryotic cells are very small and do not have nuclei or other membrane-bound organelles.

Evolution The process by which there is a gradual change in the **genetic** make-up of **species** over time, including long periods of time. Evolution can give rise to new species if sufficient change occurs.

Excretion, Excrete The removal of waste products produced in reactions which take place in the body. Many drugs are eventually broken down in the body and the products are excreted by the kidneys.

Exocrine A gland that secretes substances into a duct is called an exocrine gland. The salivary glands and the **pancreas** are examples of exocrine glands.

Exocytosis A process which involves the transport of substances out of cells. **Proteins** made in a cell are often modified in the **Golgi apparatus**. **Vesicles** are pinched off from the Golgi apparatus and these contain the modified protein. The vesicles move through the **cytoplasm** and fuse with the **cell surface membrane**, releasing the protein from the cell.

Extinction The process by which a **species** becomes extinct. A species is extinct when there are no living members of the species in the wild or in captivity.

Extracellular 'Extra' means outside, so extracellular is outside cells. Extracellular **digestion**, for example, is digestion that takes place outside cells. **Bacteria** and other **saprobionts** secrete **enzymes** onto the surface of their food and digest it outside their cells.

F_1 A term used in genetics to refer to the offspring of a cross between two organisms.

F_1 hybrid Offspring produced by crossing two different pure-bred lines. Pure-bred plant lines have been **inbred** for many generations. These inbred lines are usually not very productive because they are **homozygous** for a number of unfavourable **recessive alleles**. When plants from these inbred lines are crossed, the F_1

hybrids produced will be **heterozygous** for most of these recessive alleles. The F_1 plants will produce much higher yields than either of the parent strains.

Facilitated diffusion **Diffusion** is the movement of a substance from where it is in a high concentration to where it is in a lower concentration. Large molecules and ions can only cross cell membranes with the aid of carrier **proteins**. This form of diffusion is called facilitated diffusion.

Fallopian tube In a female mammal, the Fallopian tubes take female **gametes** from the **ovaries**. **Fertilisation** usually takes place near the top of these tubes. The fertilised eggs are then moved down to the **uterus** by **ciliated** cells lining the tubes and by contraction of muscle in their walls.

Familial A condition which is found in some families but not in others. It is often inherited. For example, people with familial **hypercholesterolaemia** have a high blood **cholesterol** concentration. They have a genetic defect which produces this condition. This explains why it is found in some families but not in others.

Fatty acid Molecules containing a COOH group and a hydrocarbon chain. Some fatty acids have double bonds present between some of the carbon atoms in the hydrocarbon chain. These are known as **unsaturated** fatty acids. **Saturated** fatty acids have no double bonds in their hydrocarbon chain. Fatty acids with long hydrocarbon chains are important constituents of **triglycerides** and **phospholipids**.

Fermentation A process occurring in living organisms in the absence of oxygen. It results in the production of small organic molecules from larger ones. Fermentation by **microorganisms** has been of importance to humans for many thousands of years. Fermentation is involved in making foods such as yoghurt and cheese, in the production of alcohol, and in the synthesis of **antibiotics**.

Fertilisation, Fertilise The process in which a male **gamete** fuses with a female gamete to form a **zygote**.

Fertiliser A substance that adds mineral ions to the soil. Chemical fertilisers are made from naturally occurring rocks or by inorganic compounds. Organic fertilisers include manure and compost. When crops are harvested the substances they contain are removed as well. Because of this fertilisers are essential in intensive farming to restore the fertility of the soil.

Fibrin A **protein** involved in the process of blood clotting. Another protein called **fibrinogen** is found in the blood **plasma**. When an injury occurs, soluble fibrinogen is converted to insoluble fibrin. This fibrin forms a mesh over the surface of the wound, which traps red blood cells forming a blood clot.

Fibrinogen Fibrinogen is a soluble **protein** found in the blood **plasma**. When an injury occurs, fibrinogen is converted to insoluble **fibrin**. This fibrin forms a mesh over the surface of the wound, which traps red blood cells forming a **blood clot**.

Fibrous protein A **protein** that is un-folded, often with several polypeptide chains cross-linked together for additional strength.

Fick's law A law which relates some of the factors affecting the rate of diffusion across a gas exchange surface. Fick's law states that rate of diffusion is proportional to: surface area × difference in concentration / thickness of gas exchange surface

Flagellum, Flagella A long thin hair-like process found on some **bacteria**. Flagella rotate and allow bacterial cells to move.

Fluid mosaic model A theory that describes the structure of the cell membrane as a fluid phospholipid bilayer containing proteins that function as, for example, enzymes, receptors or carriers. These can be integral proteins that are embedded in the membrane, or peripheral proteins located on the surface of the membrane.

Follicle In the **ovary** of a mammal, the developing female **gamete** is surrounded by a ball of cells forming a follicle. The follicle cells secrete some of the **hormones** that control the female reproductive cycle. When **ovulation** takes place, some of these surrounding cells are released along with the female gamete. **Enzymes** released by the **acrosome** on sperm cells cause these cells to break away and allow **fertilisation** to take place.

Food chain A sequence that represents the way in which energy is transferred from one organism in a **community** to another. An example of a food chain is: nettle plant → nettle aphid → two-spot ladybird. Food chains are linked to each other to form food webs.

Fossil fuel Fuel that is formed from **organisms** that lived long ago. Coal is an example of a fossil fuel. When the early plants which formed coal died, they did not decay because they lived in swampy conditions. Gradually the wood they contained became coal. The carbon in them

remained locked in the coal rather than being released into the air and being recycled.

Fructose Fructose is a **monosaccharide** with six carbon atoms in each of its molecules. It has the same molecular formula, $C_6H_{12}O_6$, as **glucose** but its atoms are arranged in a different way. **Sucrose** is formed from a molecule of glucose and a molecule of fructose, joined to each other by **condensation**.

Fruit A structure which develops from the **ovary** of a plant. It surrounds the developing **seeds**. Fruits play an important part in the **dispersal** of seeds, allowing them to colonise new areas.

Fungi, Fungus A **kingdom** consisting of organisms such as mushrooms and toadstools, moulds and yeasts. Fungi do not possess **chlorophyll**. They feed by **extracellular** digestion, secreting **enzymes** onto their food and digesting it outside their cells. They are made up of a mass of thread-like structures called **hyphae** and reproduce by spores. Fungi have **cell walls** but these are made of a substance called **chitin**, not **cellulose**.

G_1 phase As an organism grows, its individual cells make new cell contents and then divide. The resulting pattern of growth and **mitosis** is called the cell cycle. The G_1 or first gap phase is part of the cell cycle between the end of mitosis and start of the **S phase**. G_1 is a period of growth and **protein synthesis**.

G_2 phase As an organism grows, its individual cells make new cell contents and then divide. The resulting pattern of growth and **mitosis** is called the cell cycle. The G_2 or second gap phase is part of the cell cycle between the end of the **S phase** and the start of mitosis. G_2 is a period of growth and **protein synthesis**.

Galactose Galactose is a **monosaccharide** with six carbon atoms in each molecule. It has the same molecular formula, $C_6H_{12}O_6$, as **glucose** but its atoms are arranged in a different way. **Lactose**, the sugar found in milk, is formed from a molecule of glucose and a molecule of galactose joined to each other by **condensation**.

Gamete A sex cell, e.g. **ova** and **sperm**. In animals and plants, gametes are **haploid** and each contains a single set of **chromosomes**. A special form of cell division, meiosis, takes place in their formation. **Meiosis** results in the production of gametes with half the number of chromosomes found in a body cell. Reproduction that involves the fusion of gametes is called **sexual reproduction**.

Gas exchange surface The layer across which oxygen and carbon dioxide are exchanged.

Gated channels Channel proteins across membranes that can be opened or closed to allow or prevent transport across the membrane. They are controlled by signal proteins or change in **potential difference**.

Gel electrophoresis A technique used to separate fragments of **DNA**. The DNA fragments are placed on a jelly-like substance (a gel) that provides a stable medium through which the DNA molecules can move. The gel is connected to electrodes that produce an electrical field and the DNA fragments migrate in the field according to their overall charge and size. Smaller fragments travel faster and therefore further in a given time.

Gene, Genetic A piece of **DNA** which has a specific sequence of **nucleotide bases**. Each gene codes for a specific **protein**. An example of this in humans is the CF (**cystic fibrosis**) gene, which codes for the CFTR protein; this helps to transport chloride ions across **cell membranes**. An individual gene may have more than one form. These forms or **alleles** differ from each other in the sequences of their nucleotide bases and, as a result, produce slightly different proteins.

Gene probe A short, single-stranded piece of **DNA**. The gene probe has a **complementary nucleotide base** sequence to the **gene** which is being sought. Gene probes are either radioactive or have fluorescent molecules bound to them. This allows identification of the probe, and the gene it binds to.

Gene therapy Treatment of inherited diseases by altering a person's genetic make-up. For example, in 2003, trials were being carried out on patients with cystic fibrosis (CF). These trials involved introducing copies of the normal CF **allele** into cells in the lungs. This should allow the lung cells to produce normal CFTR protein. Some success has been achieved with this treatment and it is hoped that one day it may provide a cure.

Genetic code The information in the DNA which controls the manufacture of proteins and determines all the inherited characteristics of an organism. Each triplet of bases on the DNA is transcribed into a codon on messenger RNA; the codon either starts protein synthesis, codes for an amino acid in the protein being synthesised, **translation**, or is an instruction to stop synthesis of the protein.

Genetic diversity A measure of the genetic variation found in a particular **species**. Species whose members show a lot of genetic variation have a high genetic diversity. Species where all

the individuals are genetically very similar have a low genetic diversity. Many cultivated plants and domesticated animals have been bred for specific purposes and, as a result, are genetically very similar. Their low genetic diversity means that they may be unable to adapt if their **environment** changes.

Genetic drift The chance increase or decrease in allele frequency over time. These differences result from random **mutation** adding new **alleles** to the **population**. They can also result from organisms carrying particular alleles failing to breed.

Genetically modified, GM A term used to describe organisms when new **genes** have been inserted into them. For example, **bacteria** have been genetically modified to contain a gene that can make human insulin. An example of a genetically modified plant is maize which contains a bacterial gene; this enables the plant to make an **insecticide** that kills caterpillars feeding on the maize.

Genetic screening/testing Procedure that allows the identification of cells or individuals with a particular **DNA** sequence.

Genome All the **DNA** inside a cell. The genome contains a full set of all the **genes** controlling the growth and development of the organism of which the cell is a part.

Genotype The genotype describes an organism in terms of the alleles it contains. In pea plants the **allele** for tall plants, T, is **dominant** to that for short plants, t. A short plant always has the genotype tt. This means each of its cells contains two copies of the t allele. The genotype of a tall plant, however, may be either TT or Tt.

Genus, Genera A level of classification between **family** and **species**. The white-spotted butterfly fish belongs to the genus *Chaetodon*. Members of this genus and members of a number of closely related genera belong to the family Chaetodonitae. When scientific names are used, each **species** of organism is given a unique two-part Latin name. The first part of the name is the **genus** to which the organism belongs.

Germ cell, Germ line A **gamete**, or a cell which is able to develop into a gamete. Germ-line gene therapy involves inserting **genes** into germ cells. Any change which resulted from the insertion of such a gene would be passed on to subsequent generations. Because of the possible effects of this, germ-line gene therapy is not permitted in humans.

Germination, Germinate Germination is a process that starts when a **seed** absorbs water. Its food reserves are broken down by enzymes and the **embryo** starts to grow. The root or radicle emerges and grows down into the soil. The shoot or **plumule** grows up towards the light. The changes that take place during germination are controlled by **plant growth substances**.

Giant chromosomes In most organisms, as an **organ** grows its cells divide. The organs of some insects, however, grow in a different way. Their cells just get bigger and bigger. In these giant cells, the **DNA** replicates but mitosis does not take place. When some of these giant cells are examined under a microscope, it is possible to see giant **chromosomes**. They are many times the size of the chromosomes in other cells. The giant chromosomes are made up of many copies of each chromosome joined together. As these chromosomes can be seen with a light microscope, they are used to study chromosome behaviour.

Globular protein A **protein** where the polypeptide chain is folded into a compact spherical shape.

Glucose A simple sugar, which has six carbon atoms in each molecule. Glucose is very important in cellular **respiration** where it is broken down to release energy. **Carbohydrates** such as **starch** and **cellulose** are made from long chains of glucose molecules joined by **condensation**. The atoms in a glucose molecule can be arranged in different ways and this results in different forms of glucose. Two of these forms are alpha-glucose and beta-glucose.

Glycerol Glycerol, $C_3H_8O_3$, is constituent of many fats and oils. A **triglyceride** is formed from a molecule of glycerol and three **fatty acid** molecules. A **condensation** reaction removes water from between the glycerol and each of the fatty acids forming an **ester bond**. Glycerol is also found in **phospholipids**.

Glycogen A **polysaccharide** which is an important storage molecule in animal cells. A molecule of glycogen consists of a branched chain of alpha-**glucose** molecules joined by **glycosidic bonds**.

Glycolipid A molecule consisting of a **lipid** and a **carbohydrate**. They form part of the **cell surface membrane**. They have similar functions to glycoproteins; for example, they help cells to bind to each other to form tissues.

Glycoprotein A **protein** molecule with a **polysaccharide** attached.

Glycosidic bond The bond that forms between two sugar **monomers**.

Goblet cell Mucus-producing cell.

Golgi apparatus An **organelle** consisting of a series of flattened sacs, each one enclosed by a membrane. These membranes are continually being formed on one side and pinched off into **vesicles** on the other. Functions of Golgi apparatus include processing, packaging and secretion of **proteins**, secretion of the **carbohydrates**, which form **cell walls** in plants, and formation of **lysosomes**.

Greenhouse effect Some of the radiation reaching the Earth from the Sun has a short wavelength. It is reflected by the surface of the Earth as infrared radiation, which has a longer wavelength. Some of this infrared radiation is absorbed by **greenhouse gases** in the atmosphere. The atmosphere is warmed and this keeps the Earth's temperature high enough to support life. This process is similar to the way in which a greenhouse provides a warm environment for growing plants, so it is called the greenhouse effect.

Greenhouse gas Atmospheric gas that prevents infrared radiation escaping into space. Important greenhouse gases include carbon dioxide and methane. As a result of human activity, more of these gases are being produced. Since they stop the escape of infrared radiation, they have been linked to rising temperatures and global warming.

Guanine One of the **nucleotide bases** found in **nucleic acids**. When the two strands of nucleotides which make up a molecule of **DNA** come together, guanine always pairs with cytosine. The atoms of these two bases are arranged in such a way that three hydrogen bonds form between them.

Gymnosperm A cone-bearing plant such as a pine tree.

Habitat The particular place where a **community** of organisms is found. Peat bogs, coral reefs and cultivated fields are all habitats for particular communities of organisms.

Haemoglobin A protein found in the blood of many animals. Its main function is the transport of oxygen.

Haploid Cells or organisms in which the nuclei contain one copy of each **chromosome**. The **gametes** produced by animals and plants are haploid. In humans, 46 chromosomes are found in each body cell. This is the **diploid** number. Gametes are formed by a type of cell division called **meiosis**. This results in gametes which have 23 chromosomes so 23 is the human haploid number. This may be written as $n = 23$.

Helicobacter Spiral-shaped **bacteria** found in the stomach lining of most middle-aged people. The presence of *Helicobacter* can cause duodenal ulcers.

Hemicellulose, Hemicelluloses **Polysaccharides** that have molecules made up of short chains of various sugars. They are important in plant **cell walls** where they help to bind **cellulose microfibrils** together.

Herbicide A chemical that is used to kill plants. Glyphosate is an example of a broad-spectrum herbicide. This means that it kills not only weeds but also crop plants.

Herbivore An organism that feeds on plants. Cattle, sheep and rabbits are herbivores, so are seed-eating birds such as sparrows, and **invertebrates** such as butterflies and snails.

Hermaphrodite An organism which produces both male and female sex cells or **gametes**. Many flowering plants have both male and female sex organs and are hermaphrodites. The condition is not so common in animals but a familiar example of a hermaphrodite animal is the earthworm.

Heterozygote, Heterozygous An organism which has two different **alleles** of a particular **gene**. In cystic fibrosis, F represents the normal allele and f represents the **mutant allele**. A person with genotype Ff is a heterozygote. This person is a carrier of cystic fibrosis, but does not have the disease. They could pass the disease on to their children.

Hexose A simple sugar, which has six carbon atoms in each of its molecules. Hexoses are **monosaccharides**, each molecule consisting of a single sugar unit. **Glucose**, **galactose** and **fructose** are all hexoses.

High-density lipoprotein, HDL **Cholesterol** is a molecule that is important to the body. As it is a **lipid**, it is not soluble in water. It combines with **triglycerides** and **proteins** and is transported in the blood as a **lipoprotein**. Lipoproteins, which contain a lot of cholesterol and little triglyceride, are known as low-density lipoproteins (LDLs). A high concentration of LDLs in the blood is linked with the formation of **atheroma** and an increased risk of **cardiovascular disease**.

Histone **Chromosomes** contain **proteins** as well as **DNA**. The most abundant of these proteins are the histones. Histones help to package DNA, which is wound tightly round them. **Prokaryotic** cells such as **bacteria** do not contain histones.

Homeobox gene A **gene** that determines how an animal develops. Homeobox genes code for

proteins that bind to **DNA** and activate particular genes.

Homologous chromosomes Similar chromosomes, i.e. a **paternal chromosome** and **maternal chromosome**, form a pair of chromosomes. Human diploid cells are made up of 22 pairs of homologous chromosomes and one pair of **sex chromosomes**. Homologous chromosomes will have the same sequence of **genes** and are capable of pairing with each other when a cell divides by **meiosis**.

Homozygote, Homozygous An organism in which the **alleles** of a particular **gene** are identical to each other. For example, in **cystic fibrosis**, F represents the normal allele and f represents the **mutant** allele. There are two possible homozygotes. A person with the **genotype** FF does not have cystic fibrosis while a person with the genotype ff has cystic fibrosis.

Hormone A substance that acts as a chemical messenger. Hormones are secreted into the blood by **endocrine** glands. The blood transports them to particular organs where they help to regulate body processes. The hormone **insulin**, for example, is secreted by the **pancreas**. It travels in the blood to various organs including the liver. It is important in helping the cells of the liver to control the concentration of **glucose** in the blood.

Host A host organism is one that is infected by a **parasite**. Humans, for example are the hosts of malarial parasites and tapeworms. Other parasites include **bacteria** such as those which cause food poisoning and tonsillitis, and viruses such the genital wart virus which may lead to cervical cancer.

Huntington's disease **Genetic disease** that results from a **dominant allele**. It only manifests itself in adulthood but results in loss of nervous control and early death.

Hybrid, Hybridise, Hybridising The offspring of a cross between two different varieties or between two closely related **species**. Triticale is a cereal which is particularly important in Eastern Europe. It was produced by hybridising wheat and rye.

Hybrid vigour **Hybrids** may be produced by crossing plants which have been **inbred** for many generations. These inbred lines are usually not very productive because they are **homozygous** for a number of unfavourable **recessive alleles**. When plants from these inbred lines are crossed, the **F_1 hybrids** produced will be **heterozygous** for most of these alleles. These F_1 plants will produce much higher yields than either of the parent strains. This higher yield is described as hybrid vigour.

Hydrocarbon A substance whose molecules contain only the elements hydrogen and carbon. Methane (CH_4) is a hydrocarbon. It is an important **greenhouse gas**. Biologically important **fatty acids** have a COOH group at one end of the molecule and a long hydrocarbon tail at the other.

Hydrogen bond A weak chemical bond between electropositive hydrogen and other electronegative atoms such as oxygen. Although they require relatively little energy to break, hydrogen bonds are very important in helping to maintain the 3D shapes of some molecules. Molecules held in their 3D shape by hydrogen bonding include **DNA**, **polysaccharides** and **proteins**. It is because of hydrogen bonds that water molecules are able to stick to each other by **cohesion**.

Hydrolysis, Hydrolyse A chemical reaction where larger molecules are broken down into smaller ones by a reaction with water. Hydrolysis is very important in digesting biologically important **polymers**. The reactions where **proteins** break down to form **amino acids**, and **starch** molecules break down to form **maltose** and **glucose** are examples of hydrolysis.

Hydrophilic Water-attracting. For instance, in a **phospholipid** molecule the phosphate group attracts water molecules, and the **fatty acid** part of the molecule repels water molecules. These properties are important in the arrangement of phospholipids in **cell membranes**. The molecules form a double layer or bilayer, with the hydrophilic phosphate groups on the outside and in contact with water in the cytoplasm or outside of the membrane, and the water-repelling fatty acids on the inside, away from contact with water.

Hydrophobic Water-repelling. In a **phospholipid** molecule the **fatty acid** part of the molecule repels water molecules, and the phosphate group attracts water molecules. These properties are important in the arrangement of phospholipids in **cell membranes**. The molecules form a double layer or bilayer, with the water-repelling fatty acids facing towards the inside, away from contact with water. The hydrophilic phosphate groups are on the outside, and in contact with watery fluids in the cytoplasm or outside the membrane.

Hydrostatic pressure The pressure exerted by a liquid. In the blood system, hydrostatic pressure forces fluid out through the **capillary** walls. This is very important in the formation of **tissue**

fluid. A reduction in hydrostatic pressure brought about by water evaporating from the leaves is important in moving water up through the **xylem** of a plant.

Hypercholesterolaemia A condition in which there is a high concentration of **cholesterol** in the blood. **Familial** hypercholesterolaemia is an inherited condition in which cells do not have the receptors necessary to absorb cholesterol from the blood.

Hypertension High blood pressure, which occurs even when a person is at rest. It is thought to be one of the most important factors in the development of **cardiovascular disease**.

Hyphae **Fungi** are made up of a mass of branched thread-like structures called hyphae. In the soil, fungi play a very important part in digesting dead plant material. The hyphae secrete **enzymes** which digest large molecules, such as **cellulose** and **lignin**. They break them down into small soluble molecules, which are then absorbed over the large surface produced by the branching hyphae.

Immobilised enzyme A technique in which **enzymes** are bound to membranes or set in gel before being used. There are several advantages in doing this. It makes biotechnological processes cheaper because the enzyme can be separated from the product easily and used again. In addition, immobilised enzymes are more tolerant of higher temperatures and extremes of pH.

Impulse A wave of electrical activity that passes along a nerve or over the surface of a muscle.

Inbreeding, Inbred, Inbreeding Breeding closely related individuals together. When this process is carried out over several generations, the offspring are likely to become **homozygous** for increasing numbers of **alleles**. This helps to give rise to new varieties. However, some of these alleles are likely to be harmful **recessive** alleles. This may result in the offspring of animals or plants which have been inbred for a number of generations producing a lower yield or being less fertile. It also increases the frequency of inherited diseases and other unfavourable characteristics.

Inbreeding depression **Inbreeding** is breeding closely related individuals together. The offspring are likely to become **homozygous** for more and more harmful **recessive alleles**. This may result in the offspring of animals or plants which have been inbred for a number of generations showing inbreeding depression and producing a lower yield or being less fertile.

Independent assortment, Random assortment During the first stage of **meiosis** the arrangement of the pairs of homologous **chromosomes** on the **spindle** is at random with each chromosome acting independently. When these chromosomes are drawn to the poles of the cell during **anaphase**, this leads to many different combinations of paternal and **maternal chromosomes**. **Independent assortment** is an important source of **genetic** variation.

Induced fit theory Model to explain the way in which an **enzyme** enables a **substrate** to participate in a chemical reaction. When the substrate enters the active site, the enzyme changes shape, fitting more closely around the substrate and speeding up the rate of reaction.

Informed consent Freely giving one's agreement to a procedure (e.g. a surgical operation) after having received and understood all the relevant information.

Insecticide A type of **pesticide** used to kill insects. Pyrethrins are substances found in pyrethrum, a plant belonging to the daisy family. They are an ingredient of many insecticides.

Insulin A **hormone** produced by **endocrine** cells in the **pancreas**. It has a number of effects on the body, all of which help to regulate the blood **glucose** concentration. Insulin used to treat people with diabetes is now produced by genetically engineered **bacteria**.

Integral protein Proteins that form part of the cell membrane. They are embedded within the phospholipid bilayer and may span the membrane. They may not be fixed within the membrane and can move in the fluid phospholipid bilayer.

Integrated pest management Managing pests by combining use of chemical **pesticides** with other methods of control. One of the advantages of this approach is that much less pesticide is needed. This saves on cost as well as minimising **environmental** damage. For example, corn borer larvae are important pests of maize crops. Many farmers control corn borers with a system of integrated pest management. They combine the use of **biological control** and chemical sprays.

Interphase As an organism grows, its cells make new contents and then divide. The resulting pattern of growth and **mitosis** is called the **cell cycle**. Interphase is the stage in the cell cycle between mitotic divisions when new **organelles** are produced and **DNA replication** takes place. At the end of interphase, the cell enters mitosis and starts to divide again.

Interspecific Between different **species**. **Interspecific competition** is competition between different species of organism. **Weeds** compete interspecifically with crop plants for resources such as water, light and mineral ions. Interspecific **hybrids** are made by crossing two species. For example, wheat and rye are two different species of cereal. Plant breeders have crossed these two species to produce an interspecific **hybrid** called Triticale. Triticale combines the high quality and yield of wheat with the resistance to fungal infection of rye.

Intracellular 'Intra' means inside, so intracellular is inside cells. Intracellular reactions, for example, occur inside cells.

Intraspecific Between members of the same **species**. Intraspecific competition is **competition** between members of the same species of organism. Wheat plants growing in a field compete intraspecifically with each other for resources such as water, light and mineral ions.

Invertebrate Animals may be divided into **vertebrates** and invertebrates. Invertebrates are animals that do not have a skull and vertebral column. They include worms, snails and insects.

In vitro Refers to a process carried out in test tube conditions rather than inside a living organism. *In vitro* fertilisation (IVF) is often used to treat infertility. In this technique, the **fertilisation** of egg cells by sperms takes place outside the body. If fertilisation is successful one or more of the resulting **embryos** is implanted into the **uterus** of the mother where it will develop normally.

Ischaemia, Transient ischaemic attack Inadequate flow of blood to part of the body as a result of an **artery** becoming blocked. A transient ischaemic attack occurs when the blood supply to the brain is briefly interrupted. It produces all the symptoms of a **stroke** but the effects generally only last for a short time. During a **coronary heart attack**, part of the heart muscle becomes ischaemic. This is due to blockage of the coronary artery.

Ischaemic See **Ischaemia**.

Isoenzyme Isoenzymes are slightly different forms of a particular **enzyme**. These differences help organisms to survive changing conditions. For instance, acetylcholinesterase is an important enzyme found in the nervous system. Trout produce slightly different forms of this enzyme, each with a different optimum temperature. In this way they can live both in lowland rivers and mountain streams.

Junk DNA A complete set of human **DNA** contains approximately three thousand million **nucleotide bases**. This DNA includes all the 30 000 **genes** we need to produce the **proteins** which determine our characteristics. A lot of our DNA, however, does not code for proteins. This non-coding DNA is sometimes called junk DNA.

Justice **Ethical** principle concerned with such things as the fair distribution of resources.

Kilocalorie Unit of energy equal to 1000 **calories**. 1 kilocalorie is the amount of energy required to raise the temperature of 1 kg of water by 1 °C. The kilocalorie is often written as the Calorie (note the capital C to distinguish it from the calorie!) and is the unit of energy commonly used on foods and in diet books.

Kilojoule Unit of energy equal to 1000 joules. The joule is the SI unit of energy. The amount of energy required to raise the temperature of 1 kg of water by 1 °C is about 4.2 kilojoules.

Kingdom One of the five main groups into which all organisms are classified. These kingdoms are: **Prokaryotae**, **Protoctista**, **Fungi**, **Animalia**, **Planta**.

Lactic acid, Lactate In humans and other animals, the end product of anaerobic respiration is lactic acid. **Respiration** makes energy available to the cells of the body. If there is insufficient oxygen present, cells respire **anaerobically**. Lactic acid is produced when heart muscle respires anaerobically and causes **angina**. In conditions in the body, lactic acid is present as lactate ions.

Lactose The main sugar found in milk. Lactose is a **disaccharide**. It is made up from the two **monosaccharides**, **glucose** and **galactose**, joined to each other by **condensation**.

Larva, Larvae An immature stage in the life cycle of an animal. The larvae of many animals look very different from the adults. For instance, the corn borer is a pest of maize. The adult corn borer is a moth. The corn borer larva is a caterpillar which lives inside a maize stem.

Leydig cell A cell found in the **testis** of a mammal, which secretes testosterone. Testosterone is a male sex hormone.

Lignin, Lignified A polymer found in some plant **cell walls**. The main component of plant cell walls is **cellulose**. In **sclerenchyma** and **xylem**, the cellulose is impregnated with lignin. Lignin makes the walls stronger and more able to resist the forces on them. However, it also prevents water and salts getting through. As a result of being lignified the cell dies.

Limiting factor A factor that limits the rate of a process. If the limiting factor is increased, the process will take place at a faster rate. This increase in rate does not go on indefinitely. Eventually the rate levels off as other factors become limiting. Light intensity and carbon dioxide concentration are limiting factors for **photosynthesis**.

Lipase An **enzyme** that breaks down **triglycerides** into **glycerol** and **fatty acids**. This reaction is an example of **hydrolysis** since it involves the addition of water. Lipases are found in the digestive system and in **seeds**. In a germinating seed they break down stored triglycerides for use in **respiration** and for making new **cell membranes**.

Lipid A group of substances found in all cells. Lipids do not dissolve in water but they are soluble in organic solvents such as ethanol. A number of different substances are classified as lipids. They include **triglycerides**, **phospholipids** and **steroids**.

Lipoprotein An association between **proteins** and **lipid** molecules such as **cholesterol** and **triglycerides**. Lipoproteins are found in blood plasma and in lymph where they play an important part in the transport of lipids.

Liposome A small sphere made out of a double layer of **phospholipid** molecules. Liposomes have been used in **gene therapy**. Copies of the normal **allele** for the CFTR protein, lacking in people with **cystic fibrosis**, have been introduced into the lung cells of cystic fibrosis patients with the help of liposomes.

Lock-and-key theory Model to explain the way in which an **enzyme** (the lock) helps a **substrate** (the key) to participate in a chemical reaction.

Locus The position of a **gene** on a **chromosome**. For example, a person with the gene disease thalassaemia has two copies of the **recessive allele** that causes the disease. Each allele will be at the same position or locus on one of the copies of chromosome 11.

Low-density lipoprotein, LDL **Cholesterol** is a substance which is important to the human body. As it is a **lipid**, it is not soluble in water. It combines with **triglycerides** and **proteins** and is transported in the blood as a **lipoprotein**. Lipoproteins which contain a lot of cholesterol and little triglyceride are known as low-density lipoproteins (LDLs). A high concentration of LDLs in the blood is linked with the formation of **atheroma** and an increased risk of **cardiovascular disease**.

Lumen The space inside a hollow organ such as the gut or a blood vessel.

Lymph vessels The tubes that carry lymph – a colourless fluid, derived from **tissue** fluid, that is rich in **lipids** and contains many white blood cells.

Lymphatic system A system of vessels which returns excess fluid to the blood system. Over the course of a day, more fluid leaves the **capillaries** of the blood system than returns to them. In a healthy person, this fluid drains into lymphatic capillaries and then into larger lymph vessels before returning to the blood in the **veins** in the neck.

Lymphocyte A type of white blood cell, which has a large **nucleus** and a small amount of **cytoplasm**. Lymphocytes are part of the immune system of the body. One of their functions is to produce **antibodies**.

Lysosome An organelle containing digestive **enzymes** surrounded by a membrane. This membrane prevents the enzymes digesting the **proteins** and **lipids** in the cell. Lysosomes are involved in the breakdown of unwanted structures and in the destruction of old cells when they are replaced during development.

Macrophage A type of large white blood cell that forms part of the immune system of the body. Some macrophages are able to move round the body and collect near a site of infection. They remove **bacteria** from the body by engulfing and destroying them.

Malignant A **tumour** that destroys tissues around it and is able to spread to other areas of the body. Cells become detached from the original tumour and are carried in the blood or by the **lymphatic system** to other areas of the body where they form secondary tumours.

Maltase An **enzyme** that breaks down **maltose** to two molecules of **glucose**. This reaction involves **hydrolysis**. **Seeds** store **carbohydrates** as **starch**. When the seed **germinates**, this starch is broken down to maltose by **amylase**. The maltose is then broken down to glucose by maltase.

Maltose A **disaccharide** formed when two molecules of **glucose** join by **condensation**. Maltose is also produced when **starch** is broken down. It is found in **seeds** such as those of barley and wheat when they break down their starch stores as they start to **germinate**.

Mammal Mammals are **vertebrate** animals that share certain characteristics. All mammals feed their young on milk secreted by mammary glands, possess hair and sweat glands which play

an important role in temperature regulation and possess different types of teeth, which have different functions. Humans, cattle, dogs and cats are mammals, and so are bats and whales.

Mangrove A type of forest found in estuaries and on muddy seashores in the tropics. There are many different sorts of trees growing in a mangrove forest. Many of them have adaptations which allow their roots to get oxygen even when growing in thick mud.

Mannose Mannose is a **monosaccharide** with six carbon atoms in each of its molecules. It is one of the substances that helps to bind together the **cellulose** molecules in plant **cell walls**.

Marker gene When organisms are **genetically modified**, new **genes** are introduced into their cells. To label cells that contain a new gene, a marker gene is also inserted. The marker gene may produce resistance to an **antibiotic**. Incubating the cells with the antibiotic kills cells which have not taken up the resistance gene along with the other new gene. The use of marker genes is an effective way of finding those cells that have taken up the new gene.

Mass flow Movement down a concentration gradient of a liquid or gas and all the particles it contains, for example, blood in the circulatory system.

Mass transport system A system that transports substances in bulk from one part of an organism to another. Large organisms cannot rely on **diffusion** alone to meet their needs. It is too slow. They need mass flow to move substances rapidly over long distances. Examples of mass transport systems are the **xylem** in a flowering plant and the blood system in an animal.

Maternal chromosome One set of the chromosomes in each pair of **homologous chromosomes** comes from the mother. These are the maternal chromosomes. The other set comes from the father. These are the **paternal chromosomes**.

Meiosis A type of nuclear division that produces **gametes** or sex cells in animals and plants. Meiosis produces **haploid** cells, each of which contains half the number of **chromosomes** found in a body cell, one chromosome from each **homologous** pair.

Melanin A dark pigment found in the skin, hair and eyes. It is made in special cells called **melanocytes**. Production of melanin is increased by ultraviolet light. This is why sunlight results in the skin becoming darker in colour. Melanin protects the **DNA** of cells from the harmful effects of ultraviolet light.

Melanocyte A cell found mainly in the skin, which is responsible for making the dark pigment, **melanin**. These cells are activated by a **hormone** called **melanocyte-stimulating hormone** (MSH). Ultraviolet light increases the amount of MSH, which in turn, causes melanocytes to produce more melanin.

Melanocyte-stimulating hormone, MSH A **hormone** which activates special skin cells called **melanocytes** and causes them to make more of the dark pigment, **melanin**. Ultraviolet light increases the amount of MSH produced. This leads to more melanin being made and the skin becoming darker in colour.

Melanosome An **organelle** found in skin cells. Melanosomes contain the pigment **melanin**.

Messenger RNA Messenger RNA (mRNA) carries information from **DNA** in the **nucleus** to the **cytoplasm** for **protein transcription**.

Metabolic rate A measurement of the rate of energy release by the chemical reactions which take place in the body. Metabolic rate is usually measured in kJ m^{-2} h^{-1}. This takes into account the size of the person and the time, making it easier to compare figures.

Metabolise A term that refers to chemical reactions in the body. Drugs are eventually metabolised into other substances in the body and become less effective. For example, molecules from food are metabolised in cellular respiration.

Metamorphosis, Metamorphose Metamorphosis is the term used to describe the drastic changes in body form during an individual's lifetime. For example, the adult corn borer is a moth, while the immature stage is a **larva** which lives inside a maize stem. The larva of this insect looks very different from the adult. When the larva becomes an adult, many changes occur, both externally and internally.

Metaphase A stage in cell division in which **chromosomes** line up across the equator of the dividing cell. During metaphase, the **centromeres** on the chromosomes attach themselves to **spindle** fibres.

Metastasis A **malignant tumour** destroys the tissues around it and is able to spread to other areas of the body. Metastasis is where cells become detached from the original tumour and are carried in the blood or **lymphatic system** to other areas of the body.

Microfibril **Cellulose** is a polymer made up of long chains of beta-**glucose** molecules. In a plant **cell wall**, these cellulose molecules are arranged in bundles called microfibrils. The arrangement

of the microfibrils makes the wall of the cell very strong and helps it to resist the forces acting on it.

Micronutrient A substance required by an organism in very small amounts. Micronutrients include vitamins and mineral ions. In mammals, for example, iron is a micronutrient. Small amounts are required to produce haemoglobin and for some **enzymes** to work.

Microorganism, Microbe, Microbial An organism that is too small to see without the aid of a microscope. (The fruiting bodies of fungi are an exception to this.) There are three main groups of **microorganism**. These are **viruses**, **bacteria** and **fungi**. Many microorganisms cause diseases but bacteria and fungi also play a very important role in decomposition and the recycling of substances such as carbon. Microorganisms are also called microbes.

Micropropagation The production of new plants from individual cells or small pieces of tissue. By using this technique large numbers of **genetically modified** plants can be produced very rapidly from a single cell or **callus**. All the tiny plantlets formed will be genetically identical.

Micropyle A small pore in the coat of a **seed**. When a seed starts to **germinate**, water enters through the micropyle.

Microvillus, Microvilli A tiny hair-like projection from the cell-surface membrane of an animal cell. Microvilli are found in large numbers on the **epithelial** cells which line the small intestine. They help to increase the surface area for absorption of digested food.

Migration The movement of a **population** of animals from one **environment** to another. The timescale over which migrations take place varies a lot. Some small organisms in the sea migrate to the surface during the day and move back into deeper water at night. This is a daily migration. Birds such as swallows undergo an annual migration from Europe during the summer months to southern Africa during the northern winter.

Mitochondrion, Mitochondria, Mitochondrial An **organelle** found in plant and animal cells. It is the site of the biochemical reactions involved in **aerobic respiration**. Although mitochondria vary in size and shape, they usually appear as small, elongated structures about a micrometre in length. Each mitochondrion is surrounded by a double membrane, the inner one of which is folded to form **cristae**.

Mitosis, Mitotic The process by which the cell **nucleus** divides to give two new nuclei. Each of these new nuclei has the same number of **chromosomes** as the original nucleus. Mitosis is a continuous process but it is conveniently divided into four stages: **prophase**, **metaphase**, **anaphase** and **telophase**.

Monocotyledon, Monocot A member of the group of flowering plants which have one **cotyledon** in their **seeds**. Monocotyledons include plants such as grasses and cereals, lilies and orchids. All monocotyledons have seeds in which the **embryo** has one cotyledon, flower parts such as petals arranged in threes and leaves with veins which are parallel to each other.

Monohybrid inheritance Mode of **genetic** transmission in which a **characteristic** is determined by a single gene.

Monomers Identical or similar subunits that bond together to form **polymers**. For example **mononucleotides** bond to form nucleic acids.

Monosaccharide A **carbohydrate** that is made up of a single sugar unit. Monosccharides are small molecules which dissolve readily in water. They are classified according to how many carbon atoms they contain. **Hexoses** such as **glucose** contain six carbon atoms. **Pentoses** such as **ribose** contain five carbon atoms. Monosaccharides join together to form **disaccharides** and **polysaccharides**.

Monounsaturated Fats and oils are **triglycerides**. Triglycerides are made up from **glycerol** and **fatty acids**. Some fatty acids have double bonds present between some of the carbon atoms in the hydrocarbon chain. These are known as **unsaturated** fatty acids. A fatty acid with one double bond present in its hydrocarbon chain is a monounsaturated fatty acid.

Morals Beliefs about things that are right and things that are wrong. For example, a person might believe that fox hunting is always wrong but that eating meat is acceptable, provided the animals from which the meat comes do not suffer.

mRNA, Messenger RNA A type of RNA which acts as a messenger molecule. **Genes** are sections of **DNA** which code for particular **proteins**. DNA is too large to pass through the nuclear pore, so mRNA takes a copy of the genetic code. RNA passes out into the cytoplasm, where it enables **amino acids** to be assembled in the correct sequence to make a protein.

Mucus, Mucous A thick slimy fluid secreted by the cells lining many organs. Mucus is produced, for example, by cells in the gas-exchange system, the digestive system and the reproductive system. Apart from water, its main component is a **protein** called mucin. Mucus acts as a lubricant and as a protective layer.

Multifactorial A condition, e.g. human height, in which several **genes** and one or more environmental factors are involved. Many diseases are also **multifactorial**.

Multipotent We all started life as a multipotent single cell or **zygote**. As we grew and developed into adults, our cells became specialised for different purposes. The process by which cells become specialised is called **differentiation**. In adults, some cells still have the ability to differentiate and give rise to a variety of cell types. These cells are called multipotent **stem cells**. Multipotent stem cells in bone marrow develop into different sorts of blood cell.

Mutagen A **mutation** involves changes in the genetic material in a cell. An **environmental** factor that can increase the rate of mutation is a mutagen. Mutagens include asbestos, UV light and some of the substances found in cigarette smoke.

Mutation, Mutant, Mutate A change in the genetic material in a cell. Some mutations are concerned with very small changes to an organism's **DNA**. These are known as **gene** mutations. Mutations happen by chance, but certain environmental factors called **mutagens** can increase the rate of mutation. Mutations play an important part in breeding plants with desirable characteristics. Mutations to the genes that control cell division are a cause of cancer.

Mutualism Relationship between two different organisms which is to the benefit of both.

Myocardial infarction Another term for what is often called a 'heart attack'. The blood supply to the heart muscle may become blocked due to **coronary heart disease**. This results in the death of a region of heart muscle. The main danger is that the heart then starts to pump very rapidly without actually pumping any blood. The consequences of this may be fatal.

Myosin A **protein** which is important in muscle contraction. It is thought that this protein is also involved in bringing about the division of the **cytoplasm** when new cells are formed during cell division.

Natural selection A process in which individuals that are fitter (better adapted to their environment) are more likely to survive and pass on their **genes** to future generations. Natural selection drives evolutionary change.

Negative feedback Many substances and systems in living organisms have a set level. This is true of the concentration of **glucose** in the blood and of body temperature. Negative feedback is the process whereby a departure from this set level sets in motion changes which return it to the original level.

Neural A term meaning 'to do with nerves'. For example the neural arch on a vertebra is an arch of bone through which nerves pass.

Neurone A nerve cell. A neurone has a cell body containing a **nucleus** and one or more long thin branches along which impulses pass. Neurones carry these impulses either from **receptors** or to **effectors**. Neurones do not join directly to each other. They are separated by tiny gaps called **synapses**.

Niche A description of the precise role of an organism in its environment. In simple terms, an organism's niche is where it lives and what it does there. The niche of the two-spot ladybird would be described in terms of the **abiotic** aspects of its **habitat** such as the temperature range it can tolerate. A full description would also cover the biological aspects of its ecology such as the size of its aphid prey. An important biological principle is that no two different species have exactly the same ecological niche.

Non-specific cation channels A channel in the **cell surface membrane** that allows any positive ions through, such as Na^+ and Ca^{2+}.

Nuclear division See **Mitosis**.

Nuclear envelope A layer which surrounds the **nucleus** of a cell. It is called an envelope because it is really composed of two membranes perforated by tiny pores. **mRNA** leaves the nucleus through these nuclear pores during the process of protein synthesis.

Nucleic acid Nucleic acids are polymers made up from a number of **nucleotides** joined to each other by **condensation**. There are two sorts of nucleic acid: **DNA** and **RNA**.

Nucleolus, Nucleoli A dark staining body found in the **nucleus** of a cell. The nucleolus is involved in making **ribosomes**.

Nucleotide, Mononucleotide Nucleic acids are polymers made up from a number of **nucleotides** joined to each other by **condensation**. Each nucleotide has three components: a five-carbon or pentose sugar **ribose** in **RNA** and **deoxyribose** in **DNA**; a phosphate group; a **nucleotide base**.

Nucleotide base, Base The **nucleic acids DNA** and **RNA** are polymers. They are built up of a large number of **nucleotides**. Each nucleotide contains a five-carbon or **pentose** sugar, phosphate and a nucleotide base. Four different nucleotide bases are found in the nucleotides which make up a DNA molecule. These are **adenine**, **thymine**, **cytosine** and **guanine**. In RNA, thymine is replaced by another base, **uracil**. It is the sequence of nucleotide bases in nucleic acids which forms the basis of the genetic code.

Nucleus, Nuclei, Nuclear A large **organelle** that contains a cell's genetic material. It is enclosed by a nuclear envelope. This is composed of a double membrane perforated by tiny pores. The nucleus contains **DNA**, which is packaged into **chromosomes**. This DNA contains **genes**, which code for the **proteins** made by the cell.

Null hypothesis A useful starting point used when looking at the results of a scientific investigation. A null hypothesis assumes that there are no differences between sets of observations. A statistical test can then be used. From the results of such a test the null hypothesis can be accepted or rejected. If it is rejected, then the results are likely to be biologically significant and unlikely to be due to chance.

Obesity A person is obese if they are overweight to the extent that there are substantial health risks associated with this. Obesity can be defined as having a **body mass index** (BMI) in excess of 30.

Oedema Swelling caused by the accumulation of **tissue fluid**. For instance, tissue fluid is formed at the **arteriole** end of a **capillary**. It filters back into the **venule** end of the capillary. Excess tissue fluid is normally returned to the blood system via the **lymphatic system**. Oedema results when more tissue fluid is formed than is returned either through the venule end of the capillary or through the lymphatic system. There are various causes of oedema, including high blood pressure, starvation and blocked lymph vessels.

Oligosaccharide A **carbohydrate** that is made up of three to ten sugar units or **monosaccharides** joined by **condensation**. Oligosaccharides are combined with protein in **glycoproteins** on **cell membranes**.

Oncogene A **gene** that codes for a **protein** that stimulates the **cell cycle**. **Mutations** in these genes can lead to the cell cycle being continually active. This may result in **cancer**.

Open circulatory system The type of blood system found in insects and some other animal groups in which blood is not contained in blood vessels. Instead of being enclosed in **arteries**, **capillaries** and **veins**, blood circulates through large open spaces.

Order The level of classification between **class** and **family**. Humans are a member of the order **Primates**. The Primates include several closely related families including the family Hominidae which contains humans. The order Primates, together with other orders, is put in the class Mammalia.

Organ A structure which is made up of different **tissues** and has a specific function. The lung is an example of an organ. It is lined with **epithelial** tissue and its airways contain cartilage which is an example of a connective tissue. Lungs have a good blood supply; blood is another tissue.

Organelle A structure with a specific function found inside a cell. Some organelles, such as **mitochondria** and **chloroplasts**, are surrounded by membranes. They are called membrane-bound organelles. Other organelles such as **ribosomes** are not surrounded by membranes.

Organic base In **DNA**, each **nucleotide** contains one of the following four organic bases: **adenine, cytosine, guanine** and **thymine**.

Organism A living thing. Organisms are divided into five kingdoms: animals, plants, **fungi**, **prokaryotes** such as **bacteria**, and **protoctists**.

Osmosis Osmosis is a special sort of **diffusion**. It is the movement of water from a weak solution with a low concentration of solute molecules, to a solution with a higher concentration of solute molecules, through a **partially permeable** membrane.

Osmotic pressure The pressure due to movement of water from a solution with a low concentration of solute molecules to a solution with a higher concentration of solute molecules. The osmotic pressure exerted by blood plays an important part in the formation of **tissue fluid** and its return to **capillaries**.

Ovary, Ovaries The structure in which female **gametes** are produced. In a plant, the ovary is the part of the flower which contains the **ovules**. After fertilisation it develops into a **fruit**. In an animal, the ovaries produce the **ova** or female gametes.

Ovulation The process in which an egg cell or **ovum** is released from an **ovary**. In women, ovulation takes place approximately once every 28 days. An ovum and some of the **follicle** cells

that surround it are released from the ovary and enter the Fallopian tube.

Ovule Part of the **ovary** of a flowering plant. The ovule contains a number of **nuclei**. One of these is the egg nucleus, sometimes called the **egg cell**. This fuses with a male **gamete** to form a **zygote**. The embryo sac also contains two **polar nuclei**. These fuse with a second male gamete to form a nucleus with three sets of **chromosomes**. This eventually develops into the **endosperm**, which provides food for the developing embryo. The ovule is also called the embryo sac.

Ovum, Ova A female **gamete** or egg cell from an animal. The ovum is a large cell. It has a **nucleus** containing a single set of **chromosomes**. Its **cytoplasm** contains **protein** and **lipid** food reserves for the early development of the **embryo**. The plural of ovum is ova.

Pancreas A gland found just below the stomach. The pancreas has two important functions. The pancreas is an **endocrine** gland because it secretes the hormone insulin into the blood. It is also an **exocrine** gland because it secretes **enzymes** into a duct which takes them into the intestine. These enzymes are involved in the digestion of food.

Parasite, Parasitic An organism that lives in or on a **host** organism. The parasite gains an advantage from this relationship while the host suffers a disadvantage. Parasites of humans include malarial parasites and tapeworms, **bacteria** such as those which cause food poisoning, and viruses such the genital wart virus. Witchweed is a parasitic weed that infects crops such as maize in Africa.

Parenchyma Relatively unspecialised tissue found in plants. Parenchyma cells have thin **cellulose cell walls** and living contents. These cells are very important in providing support in young stems; they can **photosynthesise** and they can store substances such as **starch**.

Partially permeable **Cell membranes** are partially permeable. This means that they allow some molecules to pass through but not others. Partially permeable membranes let water molecules pass into or out of cells by **osmosis**.

Passive transport Movement of substances in a cell or organism without the expenditure of energy.

Paternal chromosome The **chromosomes** an organism inherits from its father. In humans, the **diploid** number of chromosomes is 46. This means the body cells have two copies of each of 23 chromosomes. During sexual reproduction, sex cells fuse to become a **zygote**. One set of the chromosomes in the zygote comes from the father: these are the paternal chromosomes. The other set comes from the mother: these are the **maternal** chromosomes.

Pathogen A general term used to describe a **microorganism** that causes disease. ***Campylobacter*** and ***Helicobacter*** are examples of pathogenic **bacteria**. Viruses are also pathogens, as are the **fungi** which cause diseases such as athlete's foot and thrush.

Pectin, Pectate A structural **carbohydrate** found in plant cell walls. Pectin consists of a mixture of **polysaccharides**, depending on its source. The majority of the structure is formed of repeating units of galacturonic acid. Pectins combine with calcium ions to form calcium pectates. Calcium pectates are found in and between plant **cell walls** where they help to cement **cellulose** fibres together.

Pentose A simple sugar with five carbon atoms in each of its molecules. Pentoses are **monosaccharides**, each molecule consisting of a single sugar unit. A pentose sugar, **ribose**, is an important component of **RNA**. **Deoxyribose** is also a pentose found in **DNA**.

Peptide bond The bond joining two amino acids in a protein. **Amino acids** join together by **condensation**. When a protein is digested, the peptide bonds are broken down by **hydrolysis**.

Pesticide A substance used to kill pests. Pesticides which are targeted at insects are known as **insecticides**; those which kill weeds are **herbicides**.

Phenotype The characteristics of an organism, which result from the **genes** the organism possesses and the **environment** in which it lives. Himalayan rabbits have white fur but black feet, ears and tail. Cross-breeding pure-bred Himalayan rabbits produces young rabbits with these characteristics. The black pigment will only develop, however, in parts of the body which are at a low temperature. A Himalayan rabbit must have the gene for making black fur. The rabbit must also be in the right environment for this black pigment to develop.

Phenylketonuria **Genetic disease** that results from a recessive **mutation**. Children with the condition develop low intelligence unless given a special diet.

Phloem, Phloem sieve tubes, Sieve tube elements, Sieve plates A plant tissue that transports the products of **photosynthesis**. It consists of a system of tubes which takes these molecules from the leaves to other areas of the plant such

as the developing flowers and fruits and the roots. Phloem provides a **mass flow system** for transport of the products of photosynthesis. Each tube is formed from a column of cells, sieve tube elements, with perforated end walls, sieve plates, to form a continuous tube.

Phosphate group PO_4^{3-}

Phospholipid A phospholipid molecule is a lipid with two distinct sections. It has a head region consisting of **glycerol** and a phosphate group. This part of the molecule is attracted to water. The other end consists of two **fatty acid** tails. This end of the molecule repels water. Phospholipids are important components of **cell membranes** where they are arranged in a bilayer with the heads pointing outwards and the tails pointing towards each other.

Phosphorylation, Phosphorylate The addition of a phosphate group to a molecule. **Cyclin-dependent kinases** are **enzymes** that help to control the **cell cycle**. When phosphate is added to cyclin-dependent kinases, they change shape and become active. ADP is phosphorylated to make ATP.

Photoperiod The light period during a day. In temperate regions the amount of daylight varies throughout the year. In the winter, it is light for a relatively short part of the day. In the summer, it is light for much longer. Photoperiod affects many living organisms. It controls when birds migrate, when plants flower, and when some marine worms lay their eggs.

Photosynthesis, Photosynthesise The process by which plants and some other organisms make **carbohydrate** using energy from light. Photosynthesis can be summarised in a simple equation: $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

Phytoplankton Plankton is a term used to describe small organisms that are found in the surface waters of lakes and oceans. Many planktonic organisms are microscopic **algae** which are able to **photosynthesise**. These organisms are referred to as phytoplankton. Tiny planktonic organisms that feed on phytoplankton make up the zooplankton.

Pili Very thin filaments found on the surface of some **bacteria**. Pili have various functions. Some transfer **DNA** between bacterial cells; others allow bacterial cells to bind to each other or to foreign cells.

Pit A region where a plant **cell wall** is very thin because only the first layer of **cellulose** has been laid down. Pits help substances to move between neighbouring plant cells.

Placebo When trials are carried out on new drugs, it is usual to divide the participants into two groups. Those in the experimental group are given the drug. A second group forms the control group. In some trials the control group are given a placebo, which contains an inactive dummy compound, indistinguishable in appearance from the drug.

Placenta In a mammal, the placenta is an organ formed partly from the tissue of the fetus and partly from the lining of the **uterus**. The mother's blood exchanges with the fetus' blood without the two actually coming in contact with each other. Oxygen and nutrients enter the fetal blood, and carbon dioxide and waste products are removed into the mother's blood. The placenta also produces a number of hormones that are important in controlling the events of pregnancy. Once a baby has been born, the placenta forms part of the 'afterbirth'.

Plantae The **kingdom** containing plants. Plants are all multicellular eukaryotic organisms. They have different sorts of cells which are specialised to form different organs. Their cells have large **vacuoles** and **cell walls** containing **cellulose**. Most plants have **chloroplasts**. Their nutrition is **autotrophic** and they are able to **photosynthesise**.

Plant growth substance A molecule which is produced in small amounts by plant cells and which controls growth and development. Plant growth substances have many commercial uses. They are used, for example, in **micropropagation** to produce new plants from **genetically modified** plant cells.

Plaque A build up of foreign matter somewhere inside the body. Plaque on teeth consists of a mixture of saliva, food and bacteria. On the inner wall of an artery, a plaque consists of a build up of calcium salts and fibrous tissue.

Plasma The liquid part of the blood. It consists mainly of water, but about 10% is made up of dissolved molecules such as **glucose**, mineral ions and **protein**. Plasma leaks out of capillaries to form tissue fluid which bathes the body cells.

Plasma membrane See **Cell membrane**.

Plasma proteins The proteins that are normally present in the liquid part of the blood, the blood **plasma**. These proteins have a number of functions. They play an important part in the formation of **tissue fluid** and its return to the blood; are involved in the formation of a **blood clot** when an injury occurs; may be **antibodies**; and help to keep the pH of the blood constant.

Plasmid A small, circular piece of **DNA** found in the cells of many **bacteria**. Plasmids can be transferred from one cell to another. They are very useful in **genetic engineering** because they can be used to insert new genes into the cells of bacteria and plants.

Plasmodesmata, Plasmodesma Small fluid-filled channels through the **cell walls** of plant cells. Plasmodesmata allow dissolved molecules such as mineral ions to pass directly from the **cytoplasm** of one cell to the cytoplasm of the next. These molecules do not have to pass through **cell membranes** or **cell walls**.

Platelet Platelets are small cell fragments forming part of blood. When blood vessels are damaged, platelets come into contact with the vessel wall. Platelets stick to the surface of a damaged blood vessel and to each other, forming a platelet plug. They also release **thromboplastin**, one of the molecules important in the series of reactions leading to the formation of a **blood clot**.

Plumule A young plant shoot. If the **seed** of a **dicotyledon** plant such as a bean is cut open, an **embryo** can be seen. A bean embryo has two **cotyledons** which act as a food store, a **radicle** or young root, and a plumule or young shoot.

Pluripotent Pluripotent cells are able to give rise to many types of specialised cell. The cells that make up the inner mass of a **blastocyst** are known as pluripotent embryonic **stem cells**.

Polar, polar molecule A molecule or part of a molecule is polar when the sharing of the electrons within it is not quite even; one end becomes slightly positive and the rest is slightly negative. Bears are polar when they are large, white and live in or near the Arctic.

Polar nuclei Two of the nuclei in a plant **embryo sac** or **ovule**. The polar nuclei fuse with one of the male nuclei in the **pollen tube** to form a nucleus with three sets of **chromosomes**. This eventually develops into the **endosperm**, which provides food for the developing embryo.

Pollen The **organ** of a seed plant that carries the male **gametes**.

Pollen grain A tiny structure produced by the male parts of a flower. A mature pollen grain has a tough outer coat and contains two male **gametes**. When a pollen grain lands on the **stigma** of a flower, it starts to grow and produce a **pollen tub**e. This pollen tube grows down through the style towards the **ovary**. Eventually the male gametes will pass down this tube into the **embryo sac** and **fertilisation** will take place.

Pollen tube When a pollen grain lands on the **stigma** of a flower, it starts to grow. It sends out a long, thin **cytoplasm-**filled tube called a pollen tube. This pollen tube grows down through the **style** towards the **ovary**. Eventually the male **gametes** will pass down this tube into the **embryo sac** and **fertilisation** will take place.

Polygenic inheritance The form of inheritance where a particular characteristic is controlled by a number of **genes**. Characteristics such as human height and skin colour and clinical conditions such as schizophrenia and Alzheimer's disease are polygenic. **Continuous variation** often results when a characteristic is **polygenic**.

Polymers Large molecules formed from the linking together of identical or similar subunits (**monomers**).

Polysaccharide A **carbohydrate** made up from a large number of sugar units or **monosaccharides** joined to each other by **condensation**. **Starch** is a polysaccharide. It is made up from **glucose** monomers and is an important storage substance. **Cellulose** is a structural polysaccharide found in plant **cell walls**. It is also built up from glucose monomers.

Polyunsaturated A fatty acid with more than one double bond present in its hydrocarbon chain is a polyunsaturated fatty acid.

Population A group of individuals belonging to one **species**. Members of a population are generally found in one place at a particular time and are able to breed with one another. Daisy plants on a sports field or frogs in a pond are examples of populations.

Positive feedback Positive feedback is the sequence of events where a change in a system sets in motion processes which causes the system to change even further. For example, water vapour in the atmosphere is one of the **greenhouse gases** which result in global warming. As a consequence of higher temperatures caused by global warming, more water will evaporate from the Earth's surface. The amount of water vapour in the atmosphere will increase further. This is an example of positive feedback.

Posterior The rear or tail end of an animal.

Postsynaptic Nerve cells or **neurones** do not join directly to each other. They are separated by tiny gaps called **synapses**. A nerve impulse travels along the first neurone, across the synapse and then along the second neurone. The second neurone is the postsynaptic neurone because it comes after the synapse.

Potential difference The voltage between two points. The voltage is a measure of the change in energy of an electric charge as it moves between those two points.

Precursor A molecule from which another molecule is produced. Alliin is a molecule found in garlic plants. When the plant is cut or damaged, an enzyme converts alliin to allicin, a molecule known to destroy **bacteria**. In this reaction, alliin is the precursor.

Predator An organism that feeds on another organism, killing it before eating it. Most familiar examples of predators, such as foxes and ladybirds, are animals and they usually prey on other animals. However, the term is sometimes used to describe animals that feed on plants, and carnivorous plants that feed on animals.

Presynaptic Nerve cells or **neurones** do not join directly to each other. They are separated by tiny gaps called **synapses**. A nerve impulse travels along the first neurone, across the synapse and then along the second neurone. The first neurone is the presynaptic neurone because it comes before the synapse.

Primary structure The sequence of amino acids in a **protein** or **polypeptide** is known as the primary structure. The primary structure will determine how the polypeptide will fold. There are twenty different amino acids and they can be combined in different ways to produce many different proteins.

Primate A member of the group of animals that includes monkeys and apes. Humans are also primates. Most primates live in trees, and many of the characteristics associated with the group, such as binocular vision and grasping hands, are adaptations to living in trees.

Progesterone A female sex hormone produced during the second half of the reproductive cycle and during pregnancy. It has a number of effects on the reproductive system. In particular, it maintains the lining of the **uterus** and prevents the contraction of muscle in the uterus.

Prokaryotae The **kingdom** containing **bacteria**. Members of the Prokaryotae share the following characteristics. They are prokaryotes. They have small cells, typically less than 10 micrometres across. These cells have no **nucleus** or other **organelles**, such as **mitochondria** or **chloroplasts**, which are surrounded by a membrane.

Prokaryote, Prokaryotic An organism which has cells that do not contain a **nucleus** or other organelles surrounded by membranes. **Bacteria** are prokaryotes. Animals and plants are **eukaryotes**; their cells have nuclei and membrane-bound organelles such as **mitochondria** and **chloroplasts**.

Prophase A stage in cell division in which the **chromosomes** become shorter and thicker. Each chromosome is visible as two strands called **chromatids**. Other events which take place during prophase are the formation of the **spindle fibres** which will eventually pull the chromatids apart, and the breakdown of the nuclear envelope.

Protease An **enzyme** that digests **protein**. This reaction involves the addition of water molecules, so it is an example of **hydrolysis**. Proteases are important digestive enzymes in animals, but they are also found in many **microorganisms** and in **seeds**. When a seed **germinates**, proteases break down proteins in the food store to give **amino acids**. These amino acids can be used to make new proteins in the developing seedling.

Protein, Protein synthesis A polypeptide is a molecule made from a large number of **amino acids** joined by **condensation**. This polypeptide, sometimes on its own, sometimes with others, is folded to form a protein. The shape of a particular protein is very important in determining its function. There are twenty different amino acids, and they can be combined in different ways to produce many different proteins. The genetic code is transcribed and translated to convert the triplet base code into a specific sequence of amino acids in the protein.

Prothrombin When a wound occurs, a series of reactions take place, which lead to the formation of a **blood clot**. Damaged tissues release **thromboplastin**. Thromboplastin converts inactive prothrombin, a blood **protein**, into active **thrombin**. Thrombin is an **enzyme** which converts **fibrinogen** to **fibrin**. Fibrin forms a mesh of protein fibres over the surface of the wound. This mesh traps red blood cells to form a **blood clot**.

Protoctista, Protoctist The **kingdom Protoctista** contains various **Protozoa**, single-celled eukaryotic organisms such as amoebae, as well as the multi-celled seaweeds.

Protoplast A plant cell which has had its **cell wall** digested away by **enzymes**. Protoplasts are often used in **genetic engineering**. Because they do not have a cell wall, it is much easier to get a new gene into a protoplast than into a whole plant cell.

Pulmonary A word meaning 'to do with the lungs'. The pulmonary **artery**, for example,

takes blood to the lungs while the pulmonary **vein** returns it from the lungs to the heart.

Pupa The stage between larva and adult in insects that undergo complete metamorphosis. At the start of metamorphosis, the larva moults into a pupa, with a tough, leathery case. Inside this pupa, many changes occur both externally and internally as the larva undergoes metamorphosis. Finally the outer case of the pupa splits and a new adult emerges.

Purkinje fibres A group of specialised muscle fibres which run between the right and left **ventricles** of the heart. They conduct the electrical impulses which cause the ventricle muscle to contract.

Radicle A young plant root. If the **seed** of a plant such as a bean is cut open, an **embryo** can be seen. This embryo has two **cotyledons** which act as a food store, a **plumule** or young shoot, and a radicle or young root.

Random assortment During the first stage of **meiosis** the arrangement of the pairs of **homologous chromosomes** is at random. When these chromosomes are drawn to the poles of the cell during **anaphase**, this leads to many different combinations of **maternal** and **paternal** chromosomes. Random assortment is an important source of genetic variation.

Recessive allele An **allele** is described as recessive if its effect is only shown when the other allele of the pair is identical. In peas, the allele for short plants, t, is recessive to the allele for tall plants, T. Only **homozygous** plants with the **genotype** tt will be short.

Replication A general term that means repetition. In **DNA** replication, an exact copy of the DNA is made prior to cell division.

Repressor molecule Molecule involved in **gene** regulation by binding to **DNA** and preventing gene transcription.

Reproductive isolation Two **populations** are described as being reproductively isolated when they are unable to breed with each other, or they produce offspring which fail to survive

Reptile A member of the **class** of animals that includes crocodiles, lizards and snakes. Reptiles have dry skin covered in scales, demonstrate internal fertilisation, and lay eggs. The eggs are sometimes retained inside the body of the female until they hatch.

Resistant An **organism** is described as resistant to a substance such as a **pesticide** or an **antibiotic** when the substance no longer affects the organism. **Genes** that give resistance to antibiotics are often used as markers in **genetic engineering**.

Respiration, Respire The process by which cells break down molecules such as **carbohydrates** to transfer energy for use in the cell. This energy is used to make **ATP**. The process is inefficient, so some energy is released and raises the temperature of the cell. **Glucose** is only one of a number of substances that can be used for respiration. When oxygen is present **aerobic** respiration takes place. Respiration can also take place in the absence of oxygen (**anaerobic** respiration).

Restriction enzyme, Restriction endonuclease One of a group of **enzymes** which is able to cut a **DNA** molecule at particular points along its length. Each restriction enzyme recognises a specific **base** sequence and will only cut a DNA molecule where this sequence occurs. Restriction enzymes are very important tools in **genetic engineering**. They can be used, for example, to isolate particular **genes** and insert them into the DNA of another **organism**. Restriction enzymes are also known as restriction endonucleases.

Rhizoid A small root-like structure found on organisms such as **algae** and mosses. The main function of a rhizoid is to anchor the organism, and in this way it is very like a root. However, it does not contain **vascular tissue**.

Ribose A five-carbon sugar. Ribose is an important component of **RNA**. RNA is built up of **nucleotides**. Each nucleotide is formed from ribose, a phosphate group and a nucleotide base linked together by **condensation**.

Ribosome A small **organelle** made of **RNA** and **protein** found either free in the **cytoplasm** or attached to the membranes of the **rough endoplasmic reticulum**. Protein synthesis takes place on ribosomes.

Rights Things that should nearly always be allowed. So, most people believe that humans have such rights as the right to life, the right to freedom of speech, the right to a fair trial and so on. Under certain circumstances a person may lose a right; I don't have the right to freedom of speech if that means shouting 'fire' in a crowded public place when there is no fire. If someone has a right to something, it usually means that one or more people have **duties** to that person.

RNA Ribonucleic acid. A single-stranded molecule containing the sugar **ribose**, a **phosphate** group and one of the four organic acids: **adenine**, **cytosine**, **guanine** and **uracil**.

RNA polymerase An **enzyme** involved in the process of **transcription**. During this process, **RNA nucleotides** present in the **nucleus** pair with complementary nucleotides on the template strand of the **DNA**. RNA polymerase is the enzyme which helps join the RNA nucleotides together to form a strand of mRNA.

Root hair A thin hair-like structure which grows out from a cell in the **epidermis** of a root. Root hairs are usually found on young roots in the region just behind the tip. They provide a large surface area through which mineral ions and water are absorbed.

Rough endoplasmic reticulum, Rough ER A network of interconnected sacs in the cytoplasm of a cell. These sacs are surrounded by membranes. There are **ribosomes** attached to the outer surfaces of the membranes. **Proteins** made by the ribosomes are transported through the endoplasmic reticulum to other parts of the cell.

rRNA, Ribosomal RNA Ribosomal RNA or rRNA is a type of **RNA** which is found in **ribosomes**.

Saprobiont, Saprobiotic, Saprophyte **Bacteria** and **fungi** which feed on dead organic matter. Saprobiotic organisms secrete **enzymes** onto their food. These enzymes digest substances in the dead material on which the saprobionts are feeding, and break them down into smaller soluble molecules. The smaller molecules then **diffuse** into cells of the saprobiont.

Saturated A fatty acid with no double bonds present in its hydrocarbon chain is called a saturated fatty acid. A lipid made from saturated fatty acids is also described as saturated.

Sclerenchyma fibres Long, thin plant cells which are tapered at both ends. Sclerenchyma fibres help to provide plants with support. They have **cell walls** which are thickened with **lignin**. They do not have living contents.

Secondary structure The alpha-helices and beta-pleated sheets that form when the chain of amino acids in a **protein** or **polypeptide** initially folds into a 3D shape. The sequence of amino acids in the chain determines how the chain will twist and fold.

Seed A structure produced by a flowering plant containing an **embryo** and a store of food material. A seed develops from the **embryo sac** once fertilisation has taken place. The food material may be in the cotyledons, which form part of the embryo, or it may be in another tissue, the endosperm. A protective coat, the **testa**, surrounds the embryo and its food store.

Seedbank All the **seeds** produced by a particular species of plant which are present in the soil and able to **germinate** when conditions are favourable. A seedbank may contain seeds of different ages.

Self-pollinate, Self-pollination Pollination is what happens when a pollen grain lands on the stigma of a flower. The pollen grows to produce a **pollen tube**. The pollen tube grows down through the **style** towards the **ovary**. Eventually the male **gametes** will pass down this tube into the **embryo sac** and **fertilisation** will take place. Self-pollination occurs when the pollen comes from the plant which also acts as the female parent. Cross-pollination occurs when the pollen comes from a different plant.

Semi-conservative replication In **DNA** replication, each of the two resulting DNA molecules contains one 'old' (conserved) strand and one 'new' strand.

Semilunar valve, Semilunar valves A valve that prevents the backflow of blood. When the muscle in the **ventricle** wall relaxes during the cardiac cycle, the pressure in the ventricles falls below that in the **arteries** leaving the heart. Semilunar valves between these arteries and the ventricles close, preventing blood from flowing back into the ventricles. There are also semilunar valves in the walls of **veins**; these valves allow blood to be squeezed towards the heart, but prevent it going in the opposite direction.

Serum The liquid that separates from a **blood clot** when it is allowed to stand. Serum is very similar to blood **plasma**, but it does not contain **proteins** such as **fibrinogen** which are associated with clotting.

Sex chromosome One of the **chromosomes** which determines the sex of an organism. In humans and other mammals, the female has two **X chromosomes** in each of her body cells. A male has one X chromosome and one **Y chromosome**. The X and Y chromosomes are the sex chromosomes.

Sex-linked, Sex-linkage When a **gene** is carried on a **sex chromosome**, it is said to be sex-linked. In most animals, the **Y chromosome** contains very few genes. Sex-linked genes, like those that produce tortoiseshell cats, are therefore most likely to be found on the **X chromosome**.

Sexual reproduction Reproduction which involves the fusion of **gametes** or sex cells. This process is called **fertilisation**. In animals it involves a male **gamete** or **sperm** fusing with a female gamete or **ovum**. In flowering plants, a **pollen tube** grows down towards the **ovary**.

Male gametes pass down this tube into the **embryo sac** where fertilisation takes place.

Sickle cell anaemia In the disease sickle cell anaemia, there is a **mutation** in the **gene** that codes for one of the polypeptide chains in **haemoglobin**.

Single circulation A type of blood system where blood passes through the heart once in its passage round the body. Fish have a single circulation. Blood is pumped to the gills from the **ventricle** of the heart. It then goes to the other organs of the body before returning to the heart. Mammals have a **double circulation** in which blood passes through the heart twice in its passage round the body.

Single-nucleotide polymorphism, SNP There is a lot of **DNA** in a single human cell. DNA is made up from a large number of **nucleotides** joined to each other. Slight differences in the sequence of these nucleotides results in individuals differing from each other. A single-nucleotide polymorphism or SNP is a variation in a single nucleotide. Scientists have identified over a million places where single-nucleotide polymorphisms appear in humans.

Sinoatrial node, Pacemaker, SAN A small area of specialised muscle tissue in the wall of the right **atrium** of the heart. It generates electrical impulses. These spread across the surface of the atria causing them to contract at the same time. The sinoatrial node is also called the pacemaker.

Smooth endoplasmic reticulum, Smooth ER A network of interconnected sacs in the **cytoplasm** of a cell. These sacs are surrounded by membranes. Unlike **rough endoplasmic reticulum**, smooth endoplasmic reticulum does not have **ribosomes** attached to the outer surfaces of these membranes. Smooth endoplasmic reticulum makes lipids.

Somatic To do with the body. Somatic cells are the body cells, not including germ cells. Germ cells are the cells that are directly involved in reproduction, the **sperms** and the **ova** or egg cells.

Speciation The formation of a new **species**. It is generally accepted that for a new species to arise, a group of individuals has to be isolated from the rest of the **population**. There will be different selection pressures acting on the two groups which will become less and less like each other. Eventually there will come a time when they are **reproductively isolated** and can be considered as distinct species.

Species A species is a group of similar organisms which are able to breed together to produce fertile offspring. There are obvious differences between horses and donkeys. They can breed together but the offspring are sterile. Clearly, horses and donkeys belong to separate species. There are examples, however, where it is much more difficult to decide whether two organisms belong to separate species.

Species richness A simple measure of biodiversity, the number of species in a habitat.

Sperm A male **gamete** from a mammal or other animal. A mature human sperm consists of a head which contains a large **nucleus** with a single set of **chromosomes**. The head also has an **acrosome**, an **enzyme-**filled sac which plays an important part in fertilisation. The middle piece of a sperm is packed with **mitochondria**. These provide the energy for movement of the long tail which a sperm uses to swim up the female reproductive tract.

S phase The S phase is the part of the **cell cycle** between the G_1 or first gap phase and the G_2 or second gap phase. It is the part of the cycle when the cell is synthesising more **DNA**. The S in S phase stands for synthesis.

Sphincter A ring of muscle which runs round the wall of a tubular **organ**. When it contracts, it makes the lumen of the organ narrower. There are sphincter muscles where some **arterioles** join the **capillaries** they supply. The opening and closing of the sphincter muscles regulates the flow of blood to the part of the body concerned. Other sphincter muscles are found in the gut and urinary system.

Sphygmomanometer A traditional device used to measure blood pressure. It consists of an inflatable cuff that is wrapped around the upper arm, and a manometer or gauge that measures pressure.

Spindle A structure formed from protein tubules in the cytoplasm during cell division. The spindle fibres attach to the **centromeres** of the **chromosomes** and shorten. As they shorten they pull the two halves of the centromere apart. In mitosis the centromeres split and, as a result, one **chromatid** of each chromosome is pulled to each of the poles of the dividing cell. The spindle plays a similar part during **meiosis**.

Squamous epithelium **Epithelial cells** form the outer surface of many animals, and line cavities inside organs. Squamous epithelial cells are very thin and flattened; they line the walls of the **alveoli** in the lungs.

Starch An important storage **carbohydrate** found in plants. Starch is a **polysaccharide** formed from a large number of **glucose**

monomers joined together into long chains. Starch is made up of two molecules: **amylose** and **amylopectin**. In amylose, the chain of glucose molecules winds into a spiral shape. In amylopectin the chains are branched.

Stem cell A cell that has the ability to develop into different types of cell. Stem cells are found in **embryos**, but some stem cells are also found in adults. Blood stem cells for example are found in the bone marrow and can develop into the various types of specialised cell found in blood.

Steroid Steroids are lipids that do not contain **fatty acids**. **Lipids** are a group of substances which do not dissolve in water but are soluble in organic solvents such as ethanol. **Cholesterol** is a very important steroid. It is found in cell membranes and can be converted into other biologically important steroids such as the sex **hormones oestrogen** and **testosterone**.

Stigma Female part of a flower, where pollen lands during **pollination**. Stigmas have adaptations which allow them to trap pollen. When one of the pollen grains germinates, it produces a **pollen tube**. The pollen tube grows down through the tissue of the **style** to the **ovary**.

Stoma, Stomata, Stomatal A small hole or pore in the surface of a leaf through which gas exchange takes place. Water is also lost through the stomata during the process of **transpiration**. Stomata are surrounded by guard cells which are able to change the size of the stomatal pore.

Stroke A stroke occurs when a blood vessel supplying blood to the brain is narrowed, blocked or bursts. Brain damage results due to lack of oxygen to the brain. A stroke can be the result of **cardiovascular disease**. The effects of a stroke will vary according to the part of the brain affected. Symptoms include numbness, slurred speech and blurred vision. There may be paralysis on one side of the body. The more severe the damage, the less likely it is that there will be a full recovery.

Struggle for existence **Competition** for survival and reproduction between members of a species; a component of **natural selection**.

Style The part of the flower between the **stigma** and the **ovary**. During **pollination**, a **pollen** grain lands on the stigma. It germinates and produces a **pollen tube** which grows down through the tissue of the style to the ovary.

Substomatal cavity **Stomata** are small holes or pores in the surface of a leaf through which gas exchange takes place. Immediately underneath each stoma is a cell-lined space. This is the substomatal cavity. During **transpiration**, water evaporates from the surfaces of the cells lining this cavity and diffuses out through the stomata.

Substrate In biochemical reactions, a substrate is the molecule on which an **enzyme** acts. The substrate of the enzyme **amylase**, for example, is **starch** while that of **maltase** is **maltose**. Enzymes are very specific in their actions. Only a substrate molecule with a particular shape will fit the **active site** of a particular enzyme.

Sucrose A **disaccharide** formed when a molecule of **glucose** joins a molecule of **fructose** by **condensation**. Sucrose is used by plants to transport **carbohydrates** from one part of the plant to another. It is also the sugar we use in cooking.

Sugar A general name used to describe **carbohydrates** that have small molecules. Sugars can't be further broken down (**hydrolysed**) by water, and they are soluble in water. Sugars are either **monosaccharides** consisting of single sugar units or **disaccharides** where two sugar units are combined. **Glucose**, **fructose** and **sucrose** are sugars.

Super-coiling, Super-coiled When **DNA** is supercoiled, **enzymes** twist it around **protein** molecules. The **genes** on super-coiled sections of DNA are inaccessible and cannot be **transcribed**. Super-coiling of the **X chromosome** explains why some female cats have a tortoiseshell appearance.

Surface area The area (measured in units such as mm^2 or m^2) of a surface, e.g. the outside of an **alveolus**.

Surface area to volume ratio Calculated by dividing the total **surface area** of a cell or organism by its volume.

Survival of the fittest Only those individuals (the fittest) best adapted to their physical and biological **environment** are likely to survive and reproduce.

Suspensor A column of cells found in a developing **seed**. The suspensor attaches the **embryo** to the wall of the **embryo sac**.

Sustainability The principle that the use of resources (or the environment in general) should only be permitted if it can be done without damaging or reducing those resources in the long term.

Sympathetic nerve Sympathetic nerves connect the brain to the organs of the body via the spinal cord. Sympathetic nerves form unconscious, reflex pathways. They generally act in

emergencies and control the functions of organs during times of stress. For example, sympathetic nerves are involved in increasing heart rate, constriction of blood vessels and dilation of the pupils.

Synapse A small gap between two neurones. A nerve impulse travels along the first neurone. When it arrives at the synapse, it causes small amounts of a chemical neurotransmitter to be released. The neurotransmitter diffuses across the synapse and produces a nerve impulse in the second neurone.

Synaptic cleft The gap between a synaptic knob and post-synaptic membrane at a **synapse**. When a nerve impulse arrives at a synapse, it causes small amounts of a chemical neurotransmitter to be released. The neurotransmitter diffuses across the synaptic cleft and produces a nerve impulse in the second neurone.

Synaptic knob A swelling at the end of a pre-synaptic neurone. Synaptic knobs release neurotransmitter into the **synaptic cleft**.

System A group of **organs** in the body that has a specific function. For example, the heart, the **arteries** and the **veins** are organs. They work together, forming part of the circulatory system. The function of the circulatory system is to transport substances round the body. Other systems include the digestive system and excretory system.

Systemic Referring to an entire system or body. For example, mammals have a **double circulation**. Blood is pumped to the lungs from the right **ventricle** of the heart. It returns to the heart where it is pumped again, this time by the left ventricle. It now goes to all the other organs of the body. The loop of the circulatory system that supplies the majority of the body organs is described as the systemic circulation.

Systole, Atrial systole, Ventricular systole Systole involves contraction of the heart muscle. The cardiac cycle is the three-stage sequence of events that takes place during a heartbeat. During atrial systole, the atria contract, forcing blood into the **ventricles**. During ventricular systole, the ventricles contract pushing blood out through the **arteries**. The heart refills during diastole.

Systolic pressure The blood pressure during the phase of the **cardiac cycle** when the **ventricles** are relaxed.

Telophase The last stage in cell division. The **chromosomes** unravel and a new **nuclear envelope** forms. At the end of telophase in **mitosis**, the cell has two sets of identical genetic information. Each set becomes enclosed in a separate nucleus.

Template strand The **DNA** strand that is copied during **transcription**. Transcription is the first part of **protein** synthesis. In transcription, a molecule of DNA unwinds. The sequence of **nucleotides** on the template strand is used to produce a **messenger RNA** molecule by **complementary base pairing**. The other DNA strand is not copied.

Territory An area that an animal defends against other animals, usually those of the same species.

Tertiary structure The 3D structure of a protein. A **polypeptide** is a molecule made from a large number of **amino acids** joined by **condensation**. This polypeptide is folded to form a **protein**. Some sections of the polypeptide coil and fold to produce the **secondary structure** of the protein. The whole protein then folds into a specific 3D shape known as the tertiary structure. The tertiary structure of a protein is very important in determining its function.

Testa A seed coat. In flowering plants, a **seed** contains an **embryo** and a store of food material. A protective coat called the **testa** surrounds the embryo and its food store.

Testosterone A male sex **hormone**. Testosterone is secreted by cells in the testis. It has several effects on the body, including turning the developing sex organs of an embryo into those of a male.

Thalassaemia A **genetic disease** caused by **recessive alleles** of a gene involved in the manufacture of **haemoglobin**. A number of different **mutation**s can affect this gene. Someone who is **homozygous** for one of these conditions either makes no haemoglobin at all or makes haemoglobin that cannot carry out its function properly.

Therapeutic cloning Research procedure in which it is hoped that a **diploid** cell could be induced to develop so as to form a **tissue** or **organ** needed for a transplant.

Thoracic duct The thoracic duct in the neck drains most of the **lymph** from the **lymphatic system** back into the bloodstream.

Thrombin Thrombin is an **enzyme** which converts the **plasma protein fibrinogen** to **fibrin** in response to tissue damage. Fibrin forms a mesh of protein fibres over the surface of the wound. This mesh traps red blood cells to form a **blood clot**.

Thromboplastin Damaged tissues and blood **platelets** release thromboplastin.

Thromboplastin converts inactive **prothrombin**, a **plasma protein**, into active **thrombin**. Thrombin is an **enzyme** that converts **fibrinogen** to **fibrin**. Fibrin forms a mesh of protein fibres over the surface of the wound. This mesh traps red blood cells to form a **blood clot**.

Thrombosis A condition in which a blood vessel is blocked by a blood clot. If blockage is permanent, cells may be damaged since they will not be supplied with oxygen. In **arteries** supplying the heart, thrombosis may result in a heart attack or **myocardial infarction**. In arteries supplying the brain, it results in a **stroke**.

Thymine One of the four **nucleotide bases** found in **DNA**. When the two strands of nucleotides which make up a molecule of DNA come together, thymine always pairs with adenine. The atoms of the two bases are arranged in such a way that two hydrogen bonds form between them. Thymine is not found in **RNA**. It is replaced in RNA by another base, **uracil**.

Tissue A group of cells which have a similar structure, and together carry out a particular function. **Epithelial** tissue, for example, forms the outer surface of many animals. It also lines the cavities of organs such as the gut and lungs. Plants are also made up of different types of tissues including vascular tissue. **Vascular tissues** transport substances through the plant.

Tissue fluid, Interstitial fluid The fluid that surrounds the cells in the body, supplying them with the substances they need, and taking away waste products. Tissue fluid is formed when **plasma** is forced out of **capillaries**. It contains water and all the small molecules which make up blood plasma. The capillary walls, however, prevent blood cells and larger **protein** molecules from passing through. Tissue fluid is also called interstitial fluid.

Tonoplast Membrane that surrounds a **vacuole**.

Totipotent Totipotent cells can give rise to any type of specialised cell. We all started life as a single cell or **zygote**. This zygote divides by **mitosis**. After it has undergone three mitotic divisions there will be eight cells present. Each of these totipotent **embryonic stem cells** can give rise to any of the specialised cells which make up the adult human body.

Trachea When a person breathes in, air enters through the nose and mouth and is then drawn down the **trachea**. The trachea splits into two main **bronchi**, one going to the right lung and one to the left.

Transcription The process in which the genetic information contained in a **DNA** molecule is copied to produce **messenger RNA**. This is the first stage in **protein** synthesis. A molecule of DNA unwinds. The sequence of **nucleotides** on one of the strands, called the **template strand**, is used to produce a mRNA molecule by **complementary base-pairing**.

Transcription factor A **protein** that binds with **DNA** to initiate **transcription**. The transcription factors, along with **RNA polymerase**, have the effect of 'switching on' a **gene**.

Transcription initiation complex **Transcription factors** and **RNA polymerase** bind with **DNA** when a **gene** is switched on, just before transcription. The combination of transcription factors and RNA polymerase is called a transcription initiation complex, because it triggers transcription.

Transgenic A transgenic organism is one which has been **genetically modified**. It is used to describe organisms in which new **genes** have been inserted. Maize plants have been genetically modified to contain a bacterial gene. This gene enables the plant to make a substance which kills caterpillars that feed on it and would otherwise destroy it. These maize plants are described as transgenic because they contain a gene from another organism.

Translation A process which takes place on a **ribosome**, where **amino acids** are joined to form a **polypeptide**. In protein synthesis, the process of **transcription** results in the formation of a molecule of **mRNA**. This mRNA molecule leaves the nucleus and becomes attached to the ribosome where translation takes place. During translation, **tRNA** molecules collect the appropriate amino acid from the **cytoplasm** and bring it to the ribosome where the protein is being synthesised.

Translocation The transport of substances from one part of a plant to another. Organic molecules, such as sucrose, are transported through the phloem. This **mass transport system** relies on **mass flow** due to a pressure difference between the two ends of the phloem sieve tube.

Transpiration, Transpire, Transpiration stream Evaporation of water from the leaves of plants. During transpiration, water evaporates from the surfaces of the cells lining the **substomatal cavities** and diffuses out through the stomata. Water is drawn up the xylem according to the **cohesion-tension** theory to replace the water lost by evaporation.

Triglyceride A triglyceride is a **lipid**. It is made up of a molecule of **glycerol** joined to three **fatty acid** molecules. **Condensation** reactions remove water from between the glycerol and the fatty acids to form **ester bonds**. The fats and oils that form an important part of our diet are triglycerides.

Triplet code The information on **DNA** and messenger **RNA** is carried by sequences of three neighbouring bases, so there is said to be a triplet code.

Triploid Cells or organisms in which the nuclei contain three copies of each **chromosome**. During fertilisation in plants, one of the male **gametes** enters the **embryo sac** and fuses with two of the nuclei inside. Each of these three nuclei has a single set of chromosomes, so the resulting nucleus is triploid. This nucleus divides to become the **endosperm** of the **seed**.

tRNA, Transfer RNA A type of **RNA** involved in assembling **amino acids** into the correct sequence during **translation**. There are many different types of tRNA. Each one is specific to a particular amino acid. The function of these tRNA molecules is to collect the appropriate amino acid from the **cytoplasm** and bring it to the **ribosome** where the protein is being synthesised.

Tumour A swelling resulting from the uncontrolled division of cells. These abnormal cells rapidly increase in number, invading and destroying the surrounding tissues. In some tumours, individual cells eventually break away from the original tumour. They are carried by the blood or the **lymphatic system** to other areas of the body where they form new tumours. Tumours where this happens are described as **malignant** and cause **cancer**.

Tumour suppressor gene Tumour suppressor genes are genes that code for **proteins** that stop the **cell cycle** at appropriate checkpoints. **Mutations** may affect these genes and stop them from working. If this happens, the cell loses control of the cell cycle. A **tumour** may result and the person may develop **cancer**.

Turgid, Turgidity A plant cell is described as being turgid when the cell contents press against the **cell wall**. If a plant cell is surrounded by a solution with a high concentration of water molecules, water will move into the cell by **osmosis**. As a result, the volume of the cell contents will increase and press against the cell wall.

Tyrosinase An enzyme that catalyses the first step in the pathway where the **amino acid tyrosine** is changed to **melanin**, a dark pigment found in the skin. Some people (and other animals) have a **mutant allele** for the tyrosinase **gene**. As a result they are unable to make tyrosine so cannot produce melanin. Such people are described as albinos. They have white hair and skin, and no pigment in their eyes.

Tyrosine Tyrosine is an **amino acid**. In the body a biochemical pathway changes it to **melanin**, a dark pigment found in the skin. The first step in this chemical pathway is catalysed by the **enzyme tyrosinase**.

Undifferentiated An undifferentiated cell is one that has not differentiated to form one of the many types of specialised cells in the adult organism. We all started life as a single cell or **zygote**. As we grew and developed into adults, our cells became specialised for different purposes. The process by which cells become specialised is called **differentiation**.

Uracil One of the **nucleotide bases** found in **RNA**. When a strand of **mRNA** is formed on the **template strand** of a **DNA** molecule during **transcription**, a **nucleotide** containing uracil always pairs with an **adenine**-containing nucleotide on the DNA. Uracil is not found in DNA. It is replaced in DNA by another base, **thymine**.

Uterus Part of the reproductive system in a female mammal in which the fetus develops. It has an outer layer consisting mainly of muscle and an inner lining or endometrium which contains many glands and blood vessels. During pregnancy, the uterus increases enormously in size. In humans, its cavity may increase by almost five hundred times.

Utilitarianism The ethical framework that holds that the right course of action is that which maximises the amount of happiness or other good in the world. If you are a utilitarian it means that while you might, for example, normally tell the truth, there could be occasions when you would believe that the right thing to do would be to lie (provided you can lie convincingly!).

Vaccine A preparation given to a person, as an injection or orally, to stimulate some of the **white blood cells** to produce **antibodies**. Vaccines therefore help to protect against disease.

Vacuole A region in a plant cell containing cell sap and surrounded by a **cell membrane**. A large vacuole is one of the characteristic features of a plant cell and distinguishes it from an animal cell. The cell sap in the vacuole contains dissolved substances such as sugars and mineral ions. Both of these are usually at a higher

concentration than in the surrounding **cytoplasm**. Because of this, water moves into the cell and through the cytoplasm by **osmosis**. This keeps the cell **turgid** and helps it to support the plant.

Vagina Passage leading from the **uterus** to the outside in the female reproductive system of a **mammal.** The vagina has two functions. When mating takes place, it receives the penis of the male. It also acts as the birth canal when a young mammal is born.

Vascular bundle In the stems and leaves of young plants, particularly those which are not woody, the **vascular tissue** is found in bundles. These vascular bundles contain **xylem** vessels, which transport water and mineral ions up the stem to the leaves and **phloem** tubes. The phloem tubes transport the products of photosynthesis.

Vascular tissue One of the three main types of **tissue** found in a plant. Vascular tissue consists of **xylem** and **phloem**. Xylem transports water and mineral ions from the roots, up through the stem to the leaves. Phloem transports the products of **photosynthesis** from the leaves to other parts of the plant.

Vas deferens One of a pair of tubes in a male **mammal**, which carries **sperms** from the **testes** to the urethra when ejaculation takes place.

Vegetative propagation A type of **asexual** reproduction that does not involve the fusion of **gametes** or sex cells. Vegetative propagation is common in plants, and includes the growth of new plants from tubers and bulbs. Growth of new plants from runners or suckers is another example.

Vein A vein is a blood vessel which returns **blood** from the **capillaries** to the heart. In **mammals**, veins usually contain blood low in oxygen. There is one important exception to this. The pulmonary vein returns blood from the lungs. It contains blood with a high concentration of oxygen. In plants, veins are found in leaves. They help to support the leaf and contain the vascular tissue: xylem vessels and phloem tubes.

Ventral The belly or under-surface of an animal or a structure associated with it. The ventral blood vessel in a worm, for example, is a blood vessel that runs along the under-surface of the animal.

Ventricle One of the chambers of the heart. The walls of the ventricles are much thicker than those of the **atria**. When the muscles in these walls contract, blood is passed out into the **arteries**. In the heart of a mammal, there are two ventricles. The right ventricle pumps blood through the **pulmonary** artery to the lungs; the left ventricle pumps blood through the **aorta** to the other organs of the body.

Venule A blood **vessel** that takes blood from the **capillaries** to the smaller **veins**.

Vertebrate Animals may be divided into vertebrates and **invertebrates**. Vertebrates are animals which have a skull and vertebral column. They include fish, **amphibia**, **reptiles**, birds and **mammals**. Animals such as worms, snails and insects which do not have a skull and backbone are known as invertebrates.

Vesicle A small sac in the **cytoplasm** of a cell, surrounded by a **cell membrane**. The **Golgi apparatus** is an **organelle** consisting of a series of flattened sacs, each one enclosed by a membrane. These membranes are continually being formed on one side and pinched off into **vesicles** on the other. The vesicles contain substances which have been processed and packaged by the Golgi apparatus and are being transported to the **cell surface membrane**. Other vesicles are formed when substances are taken into the cell.

Virtue A good character trait (behaviour) to possess. Precisely what the virtues are is open to disagreement, and may vary from place to place and at different times in history. However, certain virtues, such as kindness and courage, are valued by most cultures.

Virus An extremely small particle which is only capable of replicating once it is inside a living cell. A virus consists of a **nucleic acid** molecule surrounded by a **protein** coat. Some large viruses also have an outer **lipid** layer. Outside the cell of its **host**, a virus is completely inert. It cannot feed, respire or multiply, so it is best regarded as non-living.

Viscosity A measure of a fluid's resistance to flow. Fluid with a high viscosity will flow more slowly due to friction within the liquid.

Waist-to-hip ratio Obesity indicator calculated by dividing waist circumference by hip circumference. In women this ratio should not be larger than 0.85; in men it should not exceed 0.9.

Weed A plant growing in a place where it is not wanted by humans. Weeds are very important economically as they **compete** with crop plants for resources such as light, water and mineral ions. As a result, the presence of weeds results in a lower crop yield.

White blood cell The blood contains several types of white blood cell, all involved in helping

the body to combat infection. The term white blood cell is a little misleading, as some are able to leave the blood and are found in the **lymphatic system** and in other tissues. They are larger than red blood cells, from which they also differ by possessing a **nucleus** and transparent **cytoplasm**.

Wilting A condition in which the leaves and young stems of a plant droop. It occurs when the amount of water lost through **transpiration** is greater than the amount which is absorbed through the roots. Under these conditions the cells of the plant lose water and are no longer **turgid**.

X chromosome In humans and other mammals, the female has two X chromosomes in each of her body cells. A male has one X chromosome and one **Y chromosome**. The X and Y chromosomes are the **sex chromosomes**. Each X chromosome is made up of two parts. The **homologous** part is identical to the same region on the Y chromosome, and enables the sex chromosomes to pair during **meiosis**. The non-homologous part is only found on the X chromosome and carries a number of **sex-linked genes**.

Xylem, Vessel Xylem is a plant **tissue** whose main function is to transport water and mineral ions from the roots, up through the stem to the leaves. It consists of a system of vessels. The walls of these vessels contain **lignin**. Lignin makes the walls stronger and more able to resist the forces on them. Xylem provides a **mass flow system** for transport of water and mineral ions.

Xylose Xylose is a **monosaccharide** with five carbon atoms in each of its molecules. It is one of the substances that help to bind together the **cellulose** molecules in plant **cell walls**.

Y chromosome One of the sex chromosomes found in a male in humans and other mammals. The female has two **X chromosomes** in each of her body cells. A male has one X chromosome and one Y chromosome in each body cell. Male development depends on a **gene** carried on the sex-determining region of the Y chromosome. The presence of this gene brings about the development of the **testes**.

Zygote In **sexual reproduction**, a male **gamete** fuses with a female gamete to form a zygote. This process is called **fertilisation**. The zygote contains two sets of chromosomes. One set comes from the mother. These are the maternal chromosomes. The other set comes from the father. These are the **paternal** chromosomes.