



# Glossary

**abiotic** Pertaining to physical and inorganic components.

**ABO blood group antigen** A major group of carbohydrate antigens on the surface of human blood cells; it is important in determining the compatibility of blood transfusions.

**abscisic acid** A growth-inhibitory hormone controlling responses of plants to stress (such as drought), frost tolerance and seed dormancy; synthesised in the carotenoid pigment pathway.

**abscission zone** A zone of tissue at the base of a petiole that regulates abscission or shedding of the leaf.

**absorption spectrum** The pattern of absorption of photons at different wavelengths of light.

**absorptive capacity** The surface area of that part of the gut over which small molecules produced by digestive enzymes can be absorbed into the blood or lymph.

**abundance** The number of individuals (size) of a population.

**accessory genetic elements** A term used to describe plasmids and phages because they are not vital to the host bacterium and can be lost from the bacterial cell.

**acetyl CoA** A two-carbon compound that is the substrate for the citric acid cycle; produced in mitochondria during the final stage of glycolysis when  $O_2$  is available, and as a product of  $\beta$ -oxidation.

**acid** A substance that is a proton donor, releasing hydrogen ions ( $H^+$ ) into solution; possessing a pH in solution below 7.

**acid growth hypothesis** The hypothesis that acidification of the plant cell wall leads to hydrolysis of restraining chemical bonds within the cell wall, allowing cell elongation driven by the turgor pressure of the wall.

**acidophile** A type of bacteria (Archaea) that survives in highly acidic environments (acid-loving).

**acoelomate** Containing no coelom (body cavity within mesoderm).

**acquired immunity** The specific immune response which is triggered after infection or other encounter with an immunogen.

**acritarch** Phytoplankton fossils; tiny spherical cells (algal cysts), some with spines.

**acrosome** Secretory vesicle in the head of the sperm containing hydrolytic enzyme, which are released during fertilisation.

**actin** A globular protein; the main structural component of microfilaments.

**actinomorphic** Describes a flower with parts arranged in a regular way (radially symmetrical).

**actinopod** A single-celled radially symmetrical protist with long slender projections (axopods) on the surface.

**Actinopterygii** Ray-finned fishes including about 25,000 living species; bichirs, sturgeons, paddlefishes and teleosts; skeleton of true bone with ray-like supports in the fins.

**actinula** A small polyp stage in the life cycle of a jellyfish.

**action potential** An electrical event that is conducted the full length of an axon without loss of amplitude because it regenerates itself at successive points; it is triggered by depolarisation that reaches the threshold potential for the membrane; it involves a rapid non-linear opening of voltage-dependent sodium channels, followed by an opening of voltage-dependent potassium channels.

**action spectrum** The absorption spectrum of light that activates photosynthesis.

**activation energy** The energy required to initiate a reaction; it is more than the minimal level to break existing bonds at the moment molecules collide.

**active response** An amplification of a local depolarisation of a neuron that dies away with distance from the point of initiation; it is triggered by depolarisation that reaches the threshold potential for the membrane.

**active site** A specialised region of an enzyme into which substrate molecules fit; a pocket or groove formed by the folding of the polypeptide chains of the enzyme (quaternary structure).

**active transport** A carrier-mediated process requiring energy derived from hydrolysis of adenosine triphosphate (ATP); it can move substances against a concentration gradient.

**adaptive radiation** The rapid evolution and divergence of members of one lineage into different niches.

**adenosine triphosphate (ATP)** An adenine-containing compound that releases free energy when its terminal phosphate bond is hydrolysed; this energy is used to drive energy-requiring reactions in cells.

**adherens junction** A subclass of anchoring junction that provides structural support and cell adhesion by cross-linking between cytoskeletons of neighbouring cells; adherens junctions may be focal (occur as a patch) or belt-like.

**adrenal cortex** An endocrine gland that secretes steroid hormones—mineralocorticoids (such as aldosterone) and glucocorticoids (such as corticosterone).

**adrenal medulla** A neurosecretory gland that secretes catecholamines—adrenaline, noradrenaline and dopamine.

**advanced** See apomorphic.

**adventitious root** A root that arises from deep within the stem of certain plants, such as at the nodes of grasses and palms.

**aerenchyma** A type of parenchyma found in aquatic plants; spongy in appearance with large gas-filled intercellular spaces.

**aerofoil** A structure that generates lift forces as it passes through a fluid (generally air or water for animals) by virtue of its asymmetrical cross-section, such as seen in the wings of birds or the pectoral fins of sharks.

**agar** A gelatinous product of red seaweeds used in microbiology and as food.

**AIDS (acquired immunodeficiency syndrome)** A disease caused by the retrovirus, human immunodeficiency lentivirus (HIV).

**air capillary** A small diameter air-filled tube that branches from the parabronchi in the bird lung and forms the site for gas exchange; as such, the space between the air capillaries is filled with a network of blood capillaries.

**akinete** A spore of a cyanobacterium that is an enlarged cell filled with food reserves and which can remain dormant.

**aldosterone** A hormone secreted by the adrenal cortex that controls the concentrations of sodium and potassium in the blood through its actions mainly on the renal tubules; it promotes sodium reabsorption and potassium secretion.

**aleurone layer** The outer layer(s) of the endosperm of cereal grains that produces enzymes required for endosperm breakdown.

**algal bloom** A population explosion of 'algal' cells in water bodies, for example cyanobacteria (blue-green algae).

**allantois** In amniotes; an outgrowth of the embryonic hindgut used for excretion during development.

**allatostatin** This is secreted by neurosecretory cells in insects; a small peptide hormone that inhibits juvenile hormone production.

**allatotropin** This is secreted by neurosecretory cells in insects; a small peptide hormone that stimulates juvenile hormone production.

**allele** One of two or more forms of a gene located in the same position on homologous chromosomes.

- allele frequency** The proportion of a particular allele in a population.
- allergen** An agent that provokes an over-reaction of the immune system.
- allograft** A graft of tissue from another individual of the same species.
- allopatric speciation** A geographic separation of populations leading to divergent evolution and formation of new species.
- allosteric interaction** This occurs when the binding of a compound to a protein induces a shape change in the protein at a site distant to the binding site.
- $\alpha$ -diversity** See diversity.
- alternation of generations** The alternation of haploid and diploid stages in the life cycle of eukaryotes.
- altruism** Behaviour whereby individuals reduce their own reproductive success to enhance the reproductive success of others (e.g. co-operating to help others raise their young).
- alveolar ducts** The final branch of the airways in lungs that terminates in the alveoli.
- amber** The hardened resin of conifers in which fossils may be preserved.
- amino acid** An organic molecule with an amino group ( $-\text{NH}_2$ , except for proline, which has an imino group  $-\text{NH}-$ ), an acidic carboxyl group ( $-\text{COOH}$ ), a hydrogen atom and a unique side chain (R-group), all bonded to a central carbon atom; the structural unit of proteins.
- ammonoid** A group of extinct cephalopod animals dominant in the Devonian period.
- ammonotelly** The pattern of nitrogenous waste excretion where excess nitrogen (mainly from digested protein) is excreted as ammonia.
- amnion** The extra-embryonic membrane enclosing an amniote embryo in a fluid-filled sac.
- amoeba** (pl. amoebae) A single celled organism that produces extensions of the cell surface (pseudopodia or 'false feet') involved in locomotion or feeding.
- amoebocyte** Amoeboid cells in the mesohyl of sponges; they are capable of engulfing and ingesting material.
- Amphibia** A class of vertebrate, including salamanders, frogs and toads.
- amphipathic molecule** A molecule in which there is a difference in water solubility between one end and the other, such as a phospholipid, which has a phosphate head (hydrophilic) and a fatty acid tail (hydrophobic).
- amplexus** A mating position used by frogs and toads involving the male climbing onto the female's back and clasping her around the abdomen.
- ampulla** A contractable sac at the base of a tube foot in the water vascular system of echinoderms.
- amylopectin** One of the polysaccharides components of starch; made of  $\alpha$ -D-glucose units.
- amyloplast** A kind of plastid containing large starch granules and very few, if any, membranes within the stroma.
- amylose** One of the polysaccharide components of starch; made of sparsely branched  $\alpha$ -D-glucose units.
- anabolic** The favouring the synthesis of tissue.
- anabolism** Metabolic reactions involving the building or synthesis of molecules.
- anaerobic** Not requiring oxygen.
- anaerobic respiration** Cellular respiration occurring in the absence of oxygen; glycolysis, fermentation.
- anal pore** The posterior opening to the digestive system.
- analogous** Structures that have a similar function as a result of convergent evolution; *compare* homologous.
- anamorph** A fungus that has lost the ability to reproduce sexually.
- anaphase** A phase of mitosis in which the two kinetochores of the centromeres separate and sister chromatids move apart.
- anapsid** A vertebrate skull that lacks one or two pairs of openings in the temples.
- anastomose** Hyphal fusion in fungi allowing migration of nuclei from one hyphal cell to another.
- anchoring junction** A junction linking neighbouring cells and providing mechanical support; includes desmosomes, hemidesmosomes and adherent junctions.
- androgen** A steroid hormone, including testosterone and dihydrotestosterone; secreted by the Leydig cells of the testes.
- angiosperm** A flowering plant.
- angiotensin II** A peptide hormone derived from the action of a kidney hormone, renin, on a blood protein, angiotensinogen, produced in the liver; its actions include vasoconstriction of peripheral blood vessels, renal retention of ions and water, and the control of mineralocorticoid secretion from the adrenal cortex.
- angle of attack** The orientation (angle) of an aerofoil or hydrofoil in relation to the direction of travel; a disc travelling through air edge-on has an angle of attack of  $0^\circ$  and travelling flat surface first of  $90^\circ$ .
- animal contest** The interactions between individuals that are attempting to gain exclusive access to a resource.
- animal pole** The pole of the egg containing relatively low concentrations of yolk.
- Animalia** The kingdom including all animals.
- anion** A negatively charged ion (e.g.  $\text{Cl}^-$ ).
- Annelida** A phylum of segmented worms.
- annual ring** A ring of xylem in trees and shrubs that represents secondary growth from one season to the next; annual rings can be used to determine the age of trees and climatic changes.
- annulus** (pl. alluni) A ring of enlarged cells with lignified walls found in sporangia of leptosporangiate ferns.
- anoxygenic photosynthesis** A photosynthetic pathway in some bacteria that does not generate oxygen; early type of photosynthesis in evolution.
- antenna** (pl. antennae) The paired appendages located on the head of an arthropod and bearing sensory receptors.
- antennal gland** The paired metanephridial excretory organs of crustaceans, which have excretory openings at the base of the antennae.
- antennule** The small antenna on the head of an arthropod; *see* antenna.
- anterior pituitary gland (adenohypophysis)** A non-neural endocrine gland in vertebrates derived from the gut; it secretes protein based hormones under the control of neurosecretions from the hypothalamus.
- anther** In a flower, part of the stamen that houses developing male reproductive cells.
- antheridium** (pl. antheridia) The male gametangium (sex organ) producing sperm (or male haploid nuclei); antheridia are unicellular in algae and fungi and multicellular in plants (bryophytes and lower vascular plants).
- Anthocerophyta** The phylum of hornworts, a group of small spore-producing, non-vascular land plants.
- Anthozoa** A class of cnidarians that includes corals and sea anemones.
- antibiotic** A naturally occurring inhibitor of bacterial protein synthesis and thus bacterial growth.
- antibody** A protein molecule produced by B cells and plasma cells in response to antigen and which reacts specifically with that antigen.

- antidiuretic hormone** A hormone that increases the permeability of the renal collecting duct to water and thus osmoconcentrates urine.
- antigen** Any molecule that can be recognised by one of the specific molecules (antibodies or T cell receptors) of the immune system.
- antipodal cell** A nutritive cell of the embryo sac of flowering plants; it lies at the end opposite the micropyle.
- antiseptic** The preventing of infection by inhibiting the action of microorganisms.
- Anura** An order of modern amphibians, including frogs and toads.
- aorta** The main artery that carries oxygenated blood from the heart to the body in higher vertebrates.
- apical complex** A structure characteristic of apicomplexan, protistan parasites, that enables the parasite to enter a host cell.
- apical dominance** This occurs in plants where the apical bud inhibits the growth of axillary buds further down the stem, resulting in a single dominant shoot; it is thought to be maintained by the auxin hormone, indole-3-acetic acid.
- apical meristem** A specialised growth region at the tip of shoots and roots; cells divide continually to produce the primary tissues and organs of the plant.
- apical organ** The site of the balance organ (statocyst) in a comb jelly (ctenophore).
- apomixis** A type of seed formation in plants where the embryo is derived only from cells in the female ovule rather than from the fusion of male and female gametes.
- apomorphic** An advanced character, one that has evolved more recently than general, ancestral features.
- apoplast** The portion of a plant tissue that lies outside the cell membranes, that is mainly the cell walls.
- apoplastic pathway** The pathway of least resistance of water from soil into the plant; through cell walls and intercellular spaces.
- apoptosis (programmed cell death)** The process of cell suicide that involves a characteristic series of events leading to death of the cell.
- appressorium** The swelling at the tip of a fungal hypha that adheres to the surface of a host.
- Apterygota** A class of minute insects that primitively lack wings, for example springtails and silverfish.
- aquaporin** A membrane channel that conducts water, present in the plasma membrane of cells in which rapid water transfer is required.
- Arachnida** A class of arthropods that includes spiders, scorpions and ticks.
- arbuscule** The finely-branched haustoria of fungi within mycorrhizal roots.
- Archaea** One of the super kingdoms (or domains) of prokaryotes (bacteria).
- archegonium** A multicellular, female gametangium (sex organ) producing egg cells; in all plants except flowering plants.
- archenteron** An embryonic cavity in animals that becomes the gut.
- Archosauria** A group of vertebrates that includes crocodiles, birds and extinct dinosaurs.
- aridity** Very dry environmental conditions.
- arteriole** Small muscular arteries leading to the capillaries.
- artery** A large blood vessel carrying blood from the heart.
- Arthropoda** A phylum that includes spiders, crustaceans and insects.
- ascocarp** A fruiting body formed from vegetative hyphae of an ascomycete fungus; encloses asci with ascospores.
- ascogonium** A female gametangium enclosing female gametes or female haploid nuclei (e.g. in ascomycete fungi).
- Ascomycota** A phylum of fungi; ascomycetes, including truffles and yeasts, that produce ascospores inside a sack-like cell, the ascus.
- ascospore** A haploid, sexual spore produced in an ascus of an ascomycete fungus.
- ascus (pl. asci)** A sac-like cell that produces ascospores (ascomycete fungi).
- asexual reproduction** Reproduction in which offspring are clones of the parent organism.
- aspect ratio** This describes wing shape; either the ratio of the span to the mean chord (width) of a wing, or the ratio of the square of the span to the surface area.
- aspirating pump** In terms of gas exchange, a pump that draws air into the lungs under negative pressure, hence the term aspiration.
- assemblage** A group of co-existing species.
- assortative mating** Non-random mating in which phenotypically alike (positive assortative mating) or non-alike (negative assortative mating) individuals mate preferentially.
- aster** An organelle associated with nuclear division; it comprises bundles of microtubules produced from a centrosome.
- Asteraceae** The Angiosperm daisy family.
- Asteroidea** A class of echinoderms; sea stars.
- atlas** The anterior first neck vertebra supporting the skull of a tetrapod.
- atom** The smallest part of an element that can exist and retain the properties of that element; comprising a central nucleus made of protons (positively charged) and neutrons (neutral charge) surrounded by one or more orbiting electrons (negatively charged).
- atomic number** The number of protons in the nucleus of an atom; characteristic for each element.
- ATP synthase** A protein complex located in the inner membrane of mitochondria; a molecular 'motor' that both pumps protons and catalyses the synthesis of ATP.
- atrial natriuretic factor (ANF)** A hormone secreted by specific cells of the cardiac atria in response to stretch; its actions include increase of urine flow and loss of body fluid volume by the inhibition of sodium and water reabsorption by the renal tubules.
- atrioventricular bundle (Bundle of His)** A group of rapidly conducting cells that leads from the atrioventricular node to the Purkinje fibres; together, they produce a co-ordinated ventricular contraction.
- atrioventricular node** A patch of modified muscle cells lying between the right atrium and ventricle in higher vertebrates; it slows the conduction of excitation between atria and ventricles.
- atrium (pl. atria)** The heart chamber that receives blood from veins or the sinus venosus and delivers it to the ventricle; *see also* spongocoel of sponges.
- Australian region** The biogeographic region including the Australian mainland and islands on the continental shelf, such as Tasmania and New Guinea.
- australopithecine** Early hominid fossils from Africa (dated back to 4.4 million years), bipedal, with a forward jutting face, a ridge above the eyes and small brain size.
- autocrine hormones** Hormones that interact with receptors on the surface of the cell that releases them.
- autograft** A graft of tissue transferred from another site on the same individual.
- autoimmune disease** A disease resulting from the development of an immune response to an individual's own antigens; usually a chronic disease, such as diabetes or arthritis.
- autoimmunity** An immune response to one's own antigens; does not necessarily lead to disease.
- autonomic nervous system** The nervous system in animals that innervates the visceral organs of the body so that their functions are not consciously controlled.
- autoregulation** The control of blood flow to a tissue caused by the direct effects of metabolites on smooth muscle of arterioles and precapillary sphincters.
- autosome** Chromosomes that exist in pairs in diploid organisms.
- autotroph** An organism able to synthesise its own food by photosynthesis or chemosynthesis.
- auxin** A type of plant hormone controlling stem elongation; synthesised in the growing shoot and root tips of plants; synthetic auxins are used as selective herbicides.
- auxin binding protein** A protein to which the plant hormone auxin specifically binds; it is involved in auxin signalling.
- Aves** A class of vertebrates; birds.
- axillary bud** A bud in the axil of a leaf.
- axis** The second vertebra in the neck of a tetrapod.
- axon** A long neuronal process, which carries the output of the neuron to the next cell.
- axon hillock** The first part of an axon, the membrane properties of which allow action potentials to be generated.

- axoneme** A precise array of microtubules covered by the plasma membrane; the structural basis of cilia or flagella.
- axopod** *See* actinopod.
- axostyle** A stiff rod-like bunch of microtubules characteristic of parabasalid unicellular flagellates (e.g. protist *Trichomonas vaginalis* found in the genital tract of humans).
- B lymphocyte (B cell)** A lymphocyte deriving from the bone marrow in mammals or bursa in birds, with capacity to differentiate into an antibody-forming plasma cell.
- backcross** In plant breeding, a cross between F<sub>1</sub> (heterozygous) individuals and either of their pure-breeding parents.
- Bacteria** A super kingdom of prokaryotes; also termed the Eubacteria or true bacteria.
- bacterium** (pl. bacteria) The smallest cellular life form on earth (*see* prokaryote).
- bacterial artificial chromosome (BAC)** A vector used to generate recombinant DNA molecules that carry very large genomic fragments.
- bacteriophage** A virus that infects and multiplies in bacteria; commonly called phage.
- balanced polymorphism** Genetic polymorphism that is stable and can be maintained in balance in terms of the Hardy-Weinberg principle; occurs if heterozygotes for particular alleles are fitter than either homozygote.
- bark** All tissues to the outside of the vascular cambium in woody stems and woody roots.
- baroreceptor** The nerve ending in the walls of blood vessels that senses blood pressure.
- basal lamina** The extracellular matrix that underlies epithelial cell layers.
- base** A substance that can accept hydrogen ions (H<sup>+</sup>) causing a decrease in their number in solution; possessing a pH above 7; *see also* nitrogenous base.
- base pairing** The pairing of nitrogenous bases (C pairs with G and A with T) on opposite sides of the two chains in the double helix DNA molecule.
- basidiocarp** A fungal fruiting body such as a toadstool or mushroom (basidiomycete fungi).
- Basidiomycota** A phylum of fungi; basidiomycetes that bear spores on a fruiting body such as a mushrooms or toadstools.
- basidiospore** A spore of a basidiomycete fungus borne externally on a basidium.
- basidium** A club-shaped fungal cell that bears basidiospores on its surface (basidiomycete fungi).
- basophil** A blood cell with granular cytoplasm and irregular nucleus which stains strongly with basophilic dyes.
- Batesian mimicry** Resemblance of one animal (the mimic) to another to the benefit of the mimic; named after the naturalist H. W. Bates.
- Bergey classification** A practical classification of bacteria that aids species identification.
- β-diversity** *See* diversity.
- β-oxidation** *See* oxidation.
- bicuspid** A type of tooth with two cusps or elevated points, as in the premolar teeth of primates.
- bilateral symmetry** The symmetry of an organism where only one plane divides the organism into two similar halves.
- bilayer** Of biomembranes, where phospholipids form two layers.
- binary fission** The process of cell division involving cleavage to create two equal-sized cells each containing one copy of the genetic information and approximately half the cytoplasm.
- binomial system** The system devised by Linnaeus, whereby the name of each kind of organism (each species) consists of two words—genus name and specific epithet.
- biodiversity** The number, relative abundance and genetic diversity of organisms on earth; *see also* species diversity.
- biodiversity hotspot** A geographically defined region with high species diversity and endemism that are under threat.
- bioenergetics** The study of energy transformations in biological systems.
- biogeochemical cycle** The movement of material through an ecosystem, from atmospheric and geologic stores through food webs and back again.
- biogeographic region** The region of the earth inhabited by unique (endemic) types of organisms.
- biolistics** A technique for introducing DNA into a cell on small particles.
- biological control** The control of a pest species by biological means, for example, introducing a herbivore to consume and control a plant pest.
- biological electron carrier** A molecule that can act to accept (or donate) electrons, for example NADP<sup>+</sup>.
- biomass** ‘Living mass’; the amount, usually expressed as weight, of organisms in a particular area at a particular times
- biome** On a global scale, ecological communities with the same structure and delineated by climate (for example grasslands of the world).
- biomembrane** Biological membranes, formed from phospholipids and glycolipids.
- biosphere** The parts of the earth that are accessible to living organisms (hydrosphere, atmosphere and lithosphere).
- biota** The fauna and flora of a given habitat or region.
- biotechnology** The use of microorganisms to produce products (e.g. drugs) and services.
- biotic** Pertaining to organisms.
- bipedalism** Walking on two hind legs, for example, in human locomotion.
- bipinnate** Compound leaves that are twice-divided; a leaf with small leaflets.
- bipolar distribution** A distribution pattern where one species lives in the Arctic region and a another related species lives in the Antarctic.
- biramous** Appendages consisting of two parts (e.g. in crustaceans).
- bisexual** A flower containing both stamens and carpels.
- bivalve** A mollusc of the class Bivalvia, such as mussels and oysters that have two shells.
- blade** The photosynthetic parts of a brown alga such as kelp, which are attached to the stipe (stem).
- blastocoel** The first cavity of the embryo; appears during cleavage.
- blastocyst** A mammalian blastula.
- blastoderm** The layer of cells of the blastula.
- blastodisc** The layer of cells of the avian embryo, forming a disc on the uncleaved yolk mass.
- blastomere** The cell of an embryo during cleavage.
- blastopore** A depression on the surface of the gastrula marking the site at which inward cell movement occurs.
- blastula** An embryo at the end of cleavage.
- blood** A liquid tissue, circulated around the body to transport substances (nutrients, gases, waste products, hormones and cells).
- bolting** The rapid elongation of the plant stem, often followed by flowering.
- bone** The relatively stiff, strong living structural material of the vertebrate skeleton, primarily composed of an organic component (the protein collagen), an inorganic component (hydroxyapatite, a form of calcium phosphate) and cells (osteocytes).
- bone marrow** The tissue in the centre of bones that produces the cells of the blood.
- book gill** In some chelicerates; an abdominal appendage, modified as a gill, that has many leaf-like folds (lamellae); for gas exchange.
- book lung** The gas-exchange organ of spiders and scorpions; similar in structure to a book gill but internal on the ventral side of the abdomen.
- bordered pits** Pores with an overarching lip; connecting water-conducting tracheids of vascular plants.
- Boreal region** From or belonging to the north; the biogeographical region of the world extending from the Polar Sea southwards and including North American and Eurasian regions (also called Holarctic).
- bovine spongiform encephalopathy** Mad cow disease caused by a prion; *see* prion.
- branchial heart** Accessory pumping structure, for example, at the base of gills in cephalopods.
- brassinosteroid** A class of plant hormones.
- brown alga** A multicellular marine seaweed that is brown in colour due to presence of the

- pigment fucoxanthin, the same as chrysophytes, haptophytes and diatoms; phylum Phaeophyte, which includes giant kelps.
- Bryophyta** A phylum of mosses; a group of small spore-producing, leafy, non-vascular land plants.
- bryozoan** A moss animal or lophophorate.
- buccal cavity** An invagination in a ciliate that is the site of ingesting prey.
- budding** A form of asexual reproduction involving the development of a new individual from outgrowths of the body wall of the parent.
- buffer** A substance that minimises changes in the pH of a solution by taking up or releasing H<sup>+</sup> ions when extraneous acids or bases are added to the solution.
- bulb** An underground storage organ formed from a swollen stem with roots on its lower surface and fleshy leaves above (e.g. an onion).
- bundle sheath** A layer of cells surrounding the veins of the leaves of some plants; it provides a link between photosynthetic mesophyll cells and vascular tissue.
- buoyancy** The tendency of an object to float; the vertical upward force of a fluid on a floating or immersed body that is equal to the weight of fluid displaced by the body.
- Burgess Shale** Famous Palaeozoic (Cambrian) fossil sites in the world; marine animal groups represented.
- bursicon (tanning hormone)** A brain neurosecretory hormone that produces hardening and darkening of the adult cuticle in insects.
- C<sub>3</sub> photosynthesis** The process of carbon fixation in most plants in which the three-carbon compound phosphoglyceric acid is the first stable product.
- C<sub>4</sub> photosynthesis** The process of carbon fixation in which four-carbon compounds (e.g. malate) are the first stable product; it is found in tropical and subtropical grasses and cereals.
- cadherins** Proteins that traverse the plasma membrane and adhere to each other in the space between adjacent cells.
- caecotrophy** The reingestion of special faecal pellets (the contents of the caecum, which are very rich in microbes) released at night, allowing utilisation of this high protein source.
- calcitonin** A peptide hormone secreted by the ultimobranchial glands in vertebrates; it lowers plasma Ca<sup>++</sup> levels by promoting uptake into bone and increasing excretion by the kidneys.
- callase** An enzyme, 1,3 β-glucanase, that degrades the polysaccharide callose.
- callose** A polysaccharide; the main component of the cell wall of pollen tubes.
- Calvin–Benson cycle** A series of light-independent reactions in the stroma of chloroplasts where carbon dioxide is converted to sugars.
- calyptra** The tissue of the old gametophyte neck that persists on the top of a moss spore capsule.
- cambium** A secondary (sheet) meristem in vascular plants; vascular cambium increases the girth of stems and roots.
- capacitance** Of a medium for a gas; the increment of concentration per increment of partial pressure for that gas.
- capacitance vessel** The large veins of an animal that hold most of the blood.
- capillary** The smallest blood vessel, where exchange of substances between blood and extravascular fluid occurs.
- capitulum** The inflorescence of daisies; small flowers clustered in a head with the appearance of one large ‘flower’.
- capsule** A dry simple fruit that opens by valves on the top; fruit typical of eucalypts.
- carapace** The dorsal, protective covering over the thorax or anterior trunk segments of crustaceans; the dorsal, protective shield in turtles.
- carbohydrate** The most abundant organic compound in nature, composed of carbon, hydrogen and oxygen; basic unit a sugar molecule.
- carbon cycle** The movement of carbon through ecosystems, with carbon dioxide being withdrawn from the atmosphere during photosynthesis and being returned by cellular respiration.
- carbon fixation** The capture of atmospheric carbon dioxide and its conversion into carbohydrates; it occurs in the stroma of chloroplasts in eukaryotes.
- cardiac centre** A centre in the brain that controls the rate and strength of the heart beat.
- cardiac output** The rate of blood flow (mL/min) from one ventricle of the heart.
- carotenoid** The orange, yellow, red or brown fat soluble pigment involved as an accessory pigment in photosynthesis; also found in flowers and fruits; carotenes and xanthophylls.
- carotid body** The peripheral chemoreceptor found in mammals and birds near the bifurcation of the common carotid artery; it responds to changes in the partial pressure of oxygen.
- carpel** The female reproductive organ of a flowering plant; it encloses ovules; it ripens to become a fruit.
- carrageenan** The product of red seaweeds used as a stabilising agent in food such as icecream.
- carrier** A membrane protein that is capable of transporting solutes across the membrane; it usually involves binding to the protein on one side of the membrane and release on the other side.
- carrying capacity** The equilibrium point in a population when the number of births and deaths balances.
- Casparian strip** The strip of suberin thickening on the radial walls of the endodermis or exodermis of plant roots; it regulates uptake of water and solutes.
- catabolic** The favouring of the breakdown of tissue.
- catabolism** Metabolic reactions involving the breakdown of molecules.
- catalysis** The process by which the activation energy of a reaction is lowered; it affects only the rate of the reaction.
- catalyst** The substance that accelerates the rate of a chemical reaction.
- catalytic amino acid** The active-site amino acids in an enzyme involved in the making or breaking of covalent bonds.
- catarrhine** Old World (Africa and Oriental region) monkey, ape or human; characterised by nostrils that are close together and directed downward.
- cation** A positively charged ion (e.g. Na<sup>+</sup>).
- cavitation** The breaking of the water column in xylem vessels under water stress.
- cell adhesion molecule** A molecule involved in the adhesion between cells, or between a cell, and the extracellular matrix.
- cell cycle** The period from the birth of a new cell by cell division, through growth of the cell and replication of its genetic material, to the generation of two daughter cells by cell division.
- cell differentiation** The process whereby a cell ceases to proliferate and adopts a specialised structure and/or role.
- cell division** The division of a cell to form two daughter cells, each containing one copy of the genetic information and approximately half the cytoplasm.
- cell elongation** The enlargement of cells in one direction.
- cell plate** The region of new cell wall that forms during cytokinesis in eukaryotic, walled cells.
- cell proliferation** The division of cells to create an increased number of cells.
- cell theory** A set of general principles that defines living organisms on the basis that they are made of cells.
- cell wall** A rigid extracellular matrix that provides support for plant, fungal and bacterial cells; plant cell walls are made primarily of cellulose, while cell walls of bacteria, fungi and algae are made of chitin.
- cellular immunity** The defence functions carried out by cells, particularly by T-cells, rather than by antibody.
- cellular respiration** The oxidation of fuel molecules, that is, removal of electrons, coupled to synthesis of ATP.
- cellulose** A structural polysaccharide present in cell walls of plants and some protists; composed of a long chain of glucose molecules.
- Cenozoic** The youngest era in the geologic time scale, from 65 million years to present day.
- centimorgan (cM)** A measure of the extent of linkage between two genes, expressed as the percentage of recombination between the two loci.
- central cell** In the egg sac, the cell containing two haploid nuclei (usually) that develops into the endosperm after fertilisation.

- central nervous system** The brain and spinal cord of vertebrates.
- centric diatom** A radially symmetrical type of diatom.
- centromere** A constricted region of a chromosome at which the two chromatids are held together during mitosis.
- centrosome** An organelle containing two centrioles at right angles at which microtubules are assembled; the microtubular organising centre in animal cells.
- cephalisation** *See* encephalisation.
- Cephalochordata** A subphylum of chordates; lancelets.
- cephalopod** A mollusc of the class Cephalopoda, including octopuses.
- cephalothorax** A united head and thorax in crustaceans and spiders.
- cercaria** (pl. cercariae) The fluke larva that develops from a redia.
- cerci** A pair of appendages found on the last segment of an insect abdomen.
- cercozoa** A group of protists that often form amoeboid cells with pseudopods connected to one another; related to forams.
- cerebral ganglia** Ganglia at the anterior end of an animal that have evolved to process information from sense organs on the head; in more advanced animals they form the basis for the brain.
- Cestoda** A class of flatworms; tape worms.
- channel** A membrane protein capable of forming a pore through the membrane to enable the rapid transfer of specific ions or water.
- character displacement** Co-existing species populations showing morphological characteristics that are adaptations that minimise competition.
- charaophyte** A type of freshwater green alga related to land plants.
- checkpoint control** A mechanism that senses the non-completion of essential cell cycle processes such as DNA replication and repair, or spindle formation, and prevents progression into the next cell cycle phase.
- chelicera** The first pair of appendages behind the mouth of a chelicerate animal that are used as fangs or pincers.
- Chelicerata** A major lineage of arthropods that includes pycnogonids, spiders, scorpions and horseshoe crabs; *see* chelicera.
- Chelonia** The order of amniotes that includes turtles; a body with protective armoured shields and horny plates.
- chemical bond** An electrostatic attraction between atoms or groups of atoms to form a stable molecule.
- chemical fossil** An organic compound produced by organisms and preserved as fossils.
- chemical potential** The usable energy of a reaction, designated  $\Delta G$ .
- chemical synapse** A narrow gap between two neurons where information is passed by release of chemicals from the presynaptic cell; the chemicals change the activity of the postsynaptic cell.
- chemiosmosis** A chemical action between substances separated by a semipermeable membrane; for example, the synthesis of ATP from ADP and phosphate is driven by the passage of protons through the membrane-bound ATP synthase complex down an electrochemical gradient.
- chemoautotroph** An organism that uses reduced inorganic substrates as sources of energy and reduces carbon dioxide to organic carbon, using water or hydrogen gas as a reductant; certain forms of bacteria.
- chemoheterotroph** An organism that uses organic substances as a source of both carbon and energy (e.g. animals and certain forms of bacteria).
- chemoreceptor** A type of receptor that binds to a particular signal molecule, a ligand.
- chemotroph** An organism that gets its energy chemically.
- chert** A black substance formed from gels of silica precipitated on the surface of ancient sea-floors; a source of Precambrian fossils.
- chiasma** (pl. chiasmata) The attachment point between chromosomes where crossing over occurs.
- chiral** A chemical compound where it cannot be superimposed on its mirror image.
- chiral pairs** Two chiral forms of a compound (*see* chiral); e.g. D-glyceraldehyde and L-glyceraldehyde.
- chitin** An insoluble nitrogenous polysaccharide, similar to cellulose, that is the main constituent of the walls of fungi and the exoskeleton of arthropods.
- chiton** A mollusc of the class Polyplacophora.
- chlorarachniophyte** A type of marine photosynthetic cercozoan; *see* cercozoa.
- chlorenchyma** A photosynthetic parenchyma cell.
- chlorofluorocarbon (CFC)** A compound used as an aerosol propellant and refrigerant; chlorine in CFCs reacts with and break down atmospheric ozone.
- chlorophyll** A light-absorbing, green pigment involved in photosynthesis.
- chloroplast** An organelle (plastid) containing membrane-bound light-absorbing pigments; functions in photosynthesis.
- chlorotic** Having an unhealthy pale colour due to a lack of chlorophyll in plant tissues.
- choanocyte** A collar cell; the flagellated cell lining the internal cavity of a sponge.
- choanoflagellate** A marine, free-living, heterotrophic unicellular organism (a protist); similar to the collar cell of a sponge.
- cholesterol** A lipid, an amphipathic sterol, abundant in animal membranes.
- Chondrichthyes** A class of chordates; cartilaginous fishes including chimaeras, sharks, skates and rays.
- chordae tendinae** The fibrous strings that connect the edges of the heart valves to the heart wall for added strength and control.
- Chordata** A phylum of deuterostome animals including acorn worms, tunicates, lancelets, lampreys and vertebrates; it is characterised by a notochord and an internal skeleton.
- chromatin** The DNA-protein complex that makes up eukaryotic chromosomes.
- chromatophore** A cell that contains pigment granules and expands and contracts under muscular control, allowing body colour change.
- chromist** A diverse group of protists called the 'brown lineage'; characterised by having chlorophyll a and c with many being heterokont flagellate; for example, *see* brown alga and chrysophyte.
- chromophore** The light-absorbing region of a protein photoreceptor; it absorbs light of a particular wavelength.
- chromoplast** A plastid containing carotenoid pigments; it is responsible for red, orange or yellow colours of some plant organs.
- chromosome** A structure containing a single DNA molecule and associated proteins; in prokaryotic cells and in the nucleus, mitochondria and chloroplasts of eukaryotic cells; nuclear chromosomes are visible during cell division.
- chrysolaminarin** A  $\beta$ -(1 $\rightarrow$ 3)-glucan, a product of photosynthesis in chrysophytes (golden flagellates).
- chrysophyte** A golden-brown photosynthetic marine flagellate, unicellular or colonial; it is characterised by the pigment fcoxanthin and heterokont flagellation.
- Chytridiomycota** A phylum of microscopic fungi in soils and water, consisting of single cells or short chains.
- ciguatera** Food poisoning caused by toxins from dinoflagellates and other marine organisms moving through the food chain; often toxin accumulates in large reef fish, which are eaten by humans.
- cilia** Short, thin extensions of cytoplasm that undergo vigorous bending movements from their base, thus providing non-muscular locomotion as a result of a powerstroke.
- ciliate** Unicellular alveolate (k. protista) with two nuclei (micro- and macro-nuclei) and numerous cilia on the surface.
- circum Antarctic current** The sea current that circulates cold water around Antarctica.
- CITES** The Convention on International Trade in Endangered Species of Wild Fauna and Flora.
- citric acid cycle** Also known as the Krebs cycle; a cyclic series of reactions involving oxidation of fuel molecules; occurs in mitochondria in eukaryotes.
- cladistic analysis** A comparative method of phylogenetic analysis based on discovering shared apomorphic characters; it is used in systematics and classification of organisms.

- cladode** A photosynthetic stem in plants with leaves reduced or absent.
- cladogram** A branching diagram or phylogenetic (evolutionary) tree that shows the relationships of organisms and their descent from a common ancestor.
- clamp connection** A feature of basidiomycete fungal hyphae that ensures that the two nuclei of the dikaryon remain together following mitosis.
- class** A higher-level taxon (grouping) used in the classification of organisms; below phyla.
- classification** A hierarchy of groups and subgroups of organisms reflecting their phylogenetic relationships; each group (taxon) is given a name and rank—kingdom, phylum, class, order, family, genus, species (*see also* taxonomy).
- cleavage** A series of mitotic cell divisions that take place in the egg after fertilisation and that result in a progressive decrease in cell size.
- cleistogamy** In flowering plants, a process that ensures self-fertilisation; anthers open and self-pollination occurs within unopened flowers.
- climacteric** A period of increased respiration in fruits that includes a set of changes resulting in fruit ripening.
- clitellum** The thickened region of the epidermis of a euclitellate worm (e.g. an earthworm) that secretes the cocoon in which eggs are deposited.
- clonal selection** A process during an immune response in which those lymphocytes that encounter their specific antigen are stimulated to proliferate, thus increasing the number of cells reacting to that antigen.
- clone** A collection of identical individuals; all the descendants derived from one individual (an organism, cell or molecule); for example, asexual reproduction of plants by cuttings, bulbs or bacteria by fission; to make a copy of DNA.
- clubmoss** A plant in the phylum LycopHYta; a vascular land plant with a homosporous life cycle; for example, *Selaginella*.
- Cnidaria** A phylum of jellyfish, anemones and corals.
- cnidocyte** A cell in a cnidarian that contains a nematocyst.
- coccolith** An ornamented calcite plate or scale, many of which cover a coccolithophoroid cell.
- coccolithophorid** A type of haptophyte, a marine unicellular flagellate; it is characterised by a wall covered with scales or coccoliths; some chalk deposits made from the skeletons of these cells.
- cocoon** A container or capsule produced by animals to house eggs or protect a developing larva and pupa.
- codes of nomenclature** International rules that govern the scientific naming of organisms; for example, codes for animals, plants, cultivated plants and bacteria.
- coding sequence** A sequence in DNA that encodes amino acids incorporated into polypeptides during protein synthesis.
- codominant** Alleles whose phenotypes are equally recognisable in the heterozygote.
- codon** A set of three nucleotides in RNA that determines the amino acid incorporated into a growing polypeptide.
- coelacanth** A fleshy-finned or lobe-finned fish of the group named SarcopTerygii, which includes land vertebrates, the tetrapods; fleshy fins are homologous to tetrapod limbs; one living genus *Latimeria* and fossils.
- coelenteron** In cnidarians; a gastrovascular cavity lined with endoderm.
- coelom** The body cavity of an animal, lined on all sides by mesoderm.
- coelomate protostome** Annelids, molluscs and arthropods that develop a body cavity (coelom) in which lie the body organs; *see also* protostome.
- coelomoduct** A tubular excretory organ that has a ciliated, funnel-like opening in the coelomic cavity to draw coelomic fluid into the tubule; it develops from the interior of an animal towards the outside, unlike nephridia.
- coenocytic** A term used to describe a cell or non-septate hypha containing numerous nuclei.
- coenzyme** A type of cofactor, required by an enzyme to function as a catalyst; a non-protein, complex organic molecule, often with a vitamin as a building unit.
- coevolution** The evolution of two species in relation to one another, such as flowers and their animal pollinators, parasites and their hosts.
- cofactor** An additional chemical component, such as a metal ion or organic molecule, required by certain enzymes in order to function.
- cohesion theory** The viewpoint that the water molecules in the xylem sap have sufficiently strong attractive forces between them that the sap rises as a continuous column (under the suction developed by transpiring shoots).
- coleoptile** The sheath that encloses the newly emerged leaves of a grass seedling.
- coleorhiza** The sheath that encloses the newly emerged root of a grass seedling.
- collagen** A structural protein of the extracellular matrix that is the most abundant protein of mammals; collagens associate into a strong sheet-like meshwork in basement lamina and form fibrils in interstitial matrices.
- collecting duct** The terminal portion of the vertebrate nephron, which conveys fluid from the distal convoluted tubule into the renal pelvis.
- collenchyma** Living plant cells strengthened with primary thickening either at the corners or on the tangential walls; these have a support function.
- colloid osmotic pressure (oncotic pressure)** Osmotic pressure due to large proteins, chiefly albumin, in the blood; it is involved in the balance between filtration and reabsorption of fluid in tissues.
- colony** A group of cells derived from a single initial cell; normally used to describe bacterial or unicellular fungal (e.g. yeast) clusters of cells, derived from a single cell, growing on a nutrient agar plate.
- column** Of an orchid; structure in the flower consisting of one or two stamens fused with the stigma and style.
- comb row** Ciliary plates, made up of fused cilia, characteristic of comb jellies (ctenophores).
- commensalism** A symbiotic interaction between two species where one benefits and the other is unaffected; it is usually one organism living with another for shelter or support (e.g. epiphyte).
- communicating junction (gap junctions)** A junction specialised for chemical and electrical communication between cells.
- community** In an ecological sense, an assemblage of populations of different species, interacting with one another, living in a particular area (e.g. pond or forest).
- community dynamics** How biological communities vary through time and space.
- community structure** The species present, their abundances and distributions in a biological community.
- companion cell** A cell type of phloem; a transfer cell involved in the loading of sucrose into the sieve cells.
- comparative morphology** The comparison of body form of organisms.
- competent** A cell that is capable of taking up DNA during genetic transformation.
- competition (intraspecific and interspecific)** Individuals of either one species (intraspecific competition) or different species (interspecific competition) striving for the same resource that is in limited supply.
- competitive exclusion principle** When one species outcompetes another for a limited resource, resulting in its local extinction.
- complement system** A series of about 20 serum proteins that activate sequentially in a cascade of reactions; triggering of the complement cascade leads to activation of non-specific defensive cells, facilitation of phagocytosis and lysis of cells.
- complementary DNA (cDNA)** A DNA copy of an RNA transcript.
- complementary sequence** A nucleotide sequence that can form a base-paired double helical structure with another sequence.
- complete metamorphosis** In advanced insects such as butterflies, a series of distinct forms during development; egg, larva, pupa and adult.
- compound eye** An eye made up of numerous simple eyes, functioning collectively; for example, in insects.
- compound leaf** A leaf divided into leaflets, each with its own stalk.
- concentration gradient** The difference in concentration of a solute between one region and another, for example, on either side of a membrane.

- Concentricycloidea** A class of echinoderms; sea daisies.
- conceptacle** A warty structure on the surface of a brown alga that contains reproductive structures.
- condensation reaction** A reaction involving removal of water molecules in the assembly of complex molecules from simpler ones.
- conduction** The passage of electrical information along the surface of a neuron; conduction is particularly rapid along an axon.
- conidiophore** Specialised fungal hypha that forms a stalk and bears spores (conidia).
- conidium** (pl. conidia) An asexual fungal spore formed on a conidiophore; for dispersal and spread of the fungus.
- Coniferophyta** A phylum of conifers; cone-bearing seed plants such as pines.
- conjugation** The process by which organisms, such as bacteria and ciliates, make direct contact and transfer DNA via plasmids or nuclei from one cell to another, leading to genetic variation.
- connective tissue** The tissue that provides structural, metabolic and defensive support for other tissues; for example, blood, bone and cartilage; the extracellular matrix is usually more abundant than cells.
- conservation genetics** A branch of biology involving the application of genetic principles to the conservation of threatened species; it is concerned particularly with the loss of variation through genetic drift.
- constitutive gene** A gene that is expressed constantly.
- constitutive secretion** The constant release of material from a cell.
- consumer** An organism that derives its energy by consuming other organisms.
- contagious** Spread by direct or indirect contact; for example, viral and bacterial diseases.
- continental shelf** The extension of the margin of a continent that extends under the sea.
- contractile ring** A ring of myosin and actin filaments responsible for pinching in of the membrane during cytokinesis in animal cells.
- contractile vacuole** An organelle of cells that excretes fluid by a pulsating action, first filling the vacuole with fluid then ejecting the fluid from the cell.
- conus arteriosus** The last chamber of a fish heart, leading to the ventral aorta and then to the gills.
- convergent evolution** Evolution whereby organisms from different, distantly related lineages come to resemble one another.
- co-operative breeding** When adults in a group do not themselves reproduce, but instead help raise the young of the breeding individuals.
- copulation** Mating between sexes associated with internal fertilisation.
- coral bleaching** Where when corals are stressed, they expel their photosynthetic partners (zooxanthellae) and become white and starve.
- coralloid roots** The coral-like upward growth of roots of certain plants (alders, cycads and she-oaks) following root hair infection by the bacterium *Frankia* or cyanobacteria.
- cork (phellem)** The outermost part of the bark; a secondary tissue produced by the cork cambium; the cells non-living at maturity, with suberised walls and impermeable to the passage of water and gases.
- cork cambium (phellogen)** A lateral meristem producing cork (phellem) to the outside of the plant and phelloderm to the inside.
- corn** An underground storage organ formed from a swollen stem; it is similar to a bulb except it is solid and lack fleshy leaves (e.g. crocus).
- coronary artery** The artery that supplies blood to the heart muscle.
- corpus** In the shoot apex of flowering plants, the inner layers of the apical dome of cells that contribute to stem formation.
- cortex (adj. cortical)** In plants, the outer region of a stem or root.
- cortical alveoli** The vesicles beneath the plasma membrane of alveolates (e.g. dinoflagellates and ciliates).
- cosmid** A vector sequence designed to generate recombinant DNA molecules that carry larger genomic fragments.
- co-transport** The coupling of the movement of one molecule down its electrochemical gradient to drive the movement of another molecule against its electrochemical gradient; a form of active transport.
- cotyledon** A leaf-like structure of flowering plant embryos involved in food storage and digestion (in most dicots) and in nutrient transfer to the endosperm (in grasses). In a plant with epigeal germination, the first leaves to emerge are the pair of cotyledons.
- countercurrent exchange** A change in a solute or gas concentration, or temperature, by the passage of a fluid in opposite directions along two closely-opposed vessels, through passive exchange; for example, heat retention in the limbs of aquatic mammals and water vapour recovery from expired air in mammals and birds; *compare* countercurrent multiplication.
- countercurrent multiplication** An increase in a solute or gas concentration by the passage of a fluid in opposite directions along two closely-opposed vessels, involving an active or passive mechanism for increasing the concentration; for example, renal osmotic concentration in the mammalian kidney by solute transport and gas secretion into the teleost swimbladder by the Root effect; *compare* countercurrent exchange.
- courtship behaviour** Interactions between members of the opposite sex that take place before mating.
- covalent bond** The bond formed between atoms due to sharing of electrons in their outermost orbitals.
- covalent modification** Modifying the chemical bond formed by the sharing of electrons between two atoms.
- coxa** (pl. coxae) The segment of the leg that attaches to the body of an insect or other arthropod.
- Craniata** A subphylum of chordates; lampreys, hagfishes and vertebrates.
- crassulacean acid metabolism (CAM)** A variation of the C<sub>4</sub> pathway of photosynthesis, in which C<sub>4</sub> and Calvin–Benson cycle reactions occur in the same cells but at different times; CAM plants fix CO<sub>2</sub> at night and convert it to carbohydrate during the day.
- cretinism** The impairment of growth and development, particularly of the nervous system, as a result of lack of thyroid hormones in children.
- Creutzfeldt-Jakob disease** A human disease caused by a prion (*see* prion); it may be caused by mad cow disease.
- crinoid** An extinct group of stalked echinoderms common in the Ordovician period.
- Crinoidea** A class of echinoderms; feather stars and sea lilies.
- cristae** The folds of the inner membrane of mitochondria.
- cross-bridges** The temporary links formed between the heads of myosin molecules and the adjacent actin molecules that are required for muscle contraction or the maintenance of muscle force.
- cross-current exchange** The perpendicular arrangement of the air capillaries to the parabronchi in bird lungs, together with the unidirectional flow of air through the parabronchi and movement of air by diffusion only in the air capillaries, that establishes a pattern of airflow with respect to the blood flowing in the lung.
- cross-fertilisation** Fertilisation after cross-pollination; synonymous with out-breeding.
- cross-pollination** The pollination of a carpel by pollen from a different individual.
- crozier** The curled branch of a dikaryotic, heterokaryotic hypha where mitosis occurs and asci form in ascomycete fungi.
- Crustacea** A subphylum of arthropods that includes crabs and crayfish.
- crustacean cardiactive peptide** A peptide hormone first identified in crustaceans; in insects it facilitates commencement of the moulting process.
- crustose** A flat, ‘crusty’ growth form (e.g. of a lichen).
- cryoprotectants** A substance used to protect cells or tissues from damage during freezing.
- cryptic** A deceptive defence mechanism by which an animal is well camouflaged and blends into the background substrate, thus reducing the risk of predation.
- cryptic female choice** A form of female choice that occurs after insemination, and in which females favour the sperm of particular males.

- cryptomonad** A flagellate protist, usually photosynthetic, that has a small anterior invagination into which two flagella are inserted; pigments similar to chromists and red algae.
- Ctenophora** A phylum of animals; comb jellies (ctenophores).
- Cubozoa** A class of cnidarians; box jellyfish.
- cutaneous exchange** An exchange of gases (or other substances) across the general body surface.
- cuticle** An outer water-resistant layer secreted by epidermis.
- cyanelle** A plastid of glaucophytes (k. Protista), which are unique in having a peptidoglycan wall as in bacteria.
- cyanobacteria** (pl. cyanobacterium) A photosynthetic eubacterium that has chlorophyll a and produces oxygen as a by-product of photosynthesis.
- Cycadophyta** A phylum of cycads, the earliest group of seed plants living today
- cyclic photophosphorylation** The process of production of ATP in plant photosynthesis in which electrons are recycled back to photosystem II and are not used in the production of NADPH (as in non-cyclic photophosphorylation).
- cyclin** A protein subunit required for the activity of cyclin-dependent kinases; protein levels vary during a cell cycle.
- cyclin-dependent kinase** An enzyme that phosphorylates other proteins and that requires a cyclin for activity; it is responsible for progression through the cell cycle.
- cyclosporin** An immunosuppressant used in medicine and derived from a fungus (*Tolypocladium inflatum*).
- cysticercus** Tapeworm larva consisting of a bladder-like structure and inverted scolex.
- cytochalasin** Anti-actin agents derived from certain fungi; they act by specifically disrupting actin microfilaments.
- cytochrome b/f complex** A protein complex on the membranes of chloroplasts that accepts electrons from photosystem II and passes them to photosystem I during photosynthesis.
- cytochrome c oxidase** The final protein complex in the electron transport chain of cellular respiration that reduces molecular oxygen to water.
- cytokine** A glycoprotein messenger molecule secreted by cells of the immune system to control the activity of other cells.
- cytokinesis** The division of the cytoplasm of a cell following mitosis or meiosis.
- cytokinins** Plant hormones promoting cell division.
- cytoplasm** The cytosol and organelles of eukaryotic cells, excluding the nucleus.
- cytoproct** The site where undigested material is excreted in a ciliate.
- cytoskeleton** A network of microtubules, microfilaments and intermediate filaments in eukaryotic cells; it is involved in functions such as the maintenance and change in cell shape, movement of organelles within the cytoplasm and cell movement.
- cytosol** An aqueous solution of molecules with a gel-like consistency within the cytoplasm of eukaryotic cells.
- cytotoxic cell (T<sub>C</sub> cells, killer T cells)** T cells that, when stimulated by antigen and lymphokines produced by T<sub>H</sub> cells, directly lyse or kill target cells recognised by T<sub>C</sub> cells on the basis of their particular antigen.
- dauciform roots** Specialised lateral roots that have swollen to the shape of a carrot (*Daucus carota*, hence dauciform); they are intensely hairy and show a lack of mycorrhizal infection.
- day-neutral plant** A plant not affected by day length for flower initiation.
- decomposer** An organism, such as some fungi and bacteria, that consumes and breaks down organic matter for energy, releasing inorganic nutrients.
- deep-sea trench** A site where the sea-floor descends back into the mantle of the earth in a process called subduction.
- defence mechanisms** Adaptations that decrease an individual's vulnerability to predators or other natural enemies.
- degrader** Organisms that feed on dead organisms and organic wastes.
- deletion** A mutation that removes one or more nucleotides from the DNA.
- demographic stochasticity** The process that describes the random nature of births and deaths in populations.
- denatured** An enzyme that has lost its characteristic three dimensional shape, for example, by heat.
- dendrite** The branching process of neurons that are generally short and receive information from other cells.
- dendritic cell** A cell of the immune system that has long branching processes and is able to break down foreign molecules and present them to lymphocytes.
- denitrification** The conversion of nitrate to nitrite and nitrite to molecular nitrogen; carried out by certain types of bacteria in ecosystems.
- denitrifying bacteria** Bacteria, mainly chemoheterotrophs, that carry out anaerobic respiration and use nitrite and nitrate as electron acceptors, releasing nitrogen gases back into the atmosphere.
- density-dependent population dynamics** In ecology, when the per capita birth and death rates of a population depend on the size of the population.
- density-independent population dynamics** In ecology, when the per capita birth and death rates of a population are independent of the size of the population; also termed density-vague.
- density-vague population dynamics** See density-independent population dynamics.
- deoxyribonucleoside triphosphate** A deoxyribose sugar covalently attached through the 1' C to either adenine, cytosine, guanine or thymine, and through the 5' C to three phosphate groups; it is polymerised to extend DNA strands during DNA replication.
- deoxyribose nucleic acid (DNA)** A nucleic acid that is the hereditary material of an organism, stored as a coded sequence of nitrogenous bases; it comprises two complementary double helical strands of nucleotides made up of a pentose sugar, phosphate group and nitrogenous base.
- depolarised** The decreased voltage difference across a membrane; it brings membrane potential closer to threshold potential and therefore is excitatory.
- deposit feeding** A type of feeding in aquatic animals where bottom sediments and detritus are ingested.
- dermal bone** Bone that develops in the skin without going through a cartilaginous phase.
- desmosome desmosomes** Provides structural support and cell adhesion by cross-linking between cytoskeletons of neighbouring cells.
- detritivore** Animals that eat organic litter or detritus (a type of degrader).
- detritus food chain** A food chain whose food base is primarily mixed debris (detritus).
- Deuteromycota** A phylum of fungi but a polyphyletic assemblage of forms, called Fungi Imperfecti, many of which have lost the ability to reproduce sexually.
- deuterostome** An animal in which, during development, the anus forms at the site of the blastopore and the mouth forms as a secondary opening; echinoderms and chordates.
- development** A series of events leading to the formation of an adult organism from a zygote.
- diapsid** A vertebrate skull with two well-defined temporal openings.
- diarrhoetic shellfish poisoning (DSP)** An illness caused by toxins from certain dinoflagellates, which move through marine food chains; it causes gastrointestinal symptoms.
- diastole** A phase of the cardiac cycle involving muscle relaxation and the filling of a heart chamber.
- diatom** A unicellular, golden-brown alga with a characteristic cell wall made of two valves of silica.
- dicotyledon** One of the major types of flowering plant (class Magnoliopsida) that typically has two embryonic leaves in the seed.
- dideoxynucleoside triphosphate (ddNTP)** Nucleoside triphosphates lacking both the 2' and 3' OH groups so that they can be incorporated into a growing DNA chain, but prevent addition of any further nucleotides, permitting rapid DNA sequence determination.
- diffusion** The net passive movement of molecules from a region where they are in high concentration to one where they are in low

- concentration; due to the random thermal motion of molecules; the passive movement of molecules along their electrochemical gradient.
- digestive enzyme** Proteins that catalyse the breakdown of complex foodstuffs into simple units that can be absorbed from the gut.
- dihybrid cross** A cross involving organisms that are heterozygous at two different loci.
- dikaryon** A fungal cell containing two haploid nuclei, one from each parent; it is usually formed after the sexual fusion of parent hyphae.
- dingo** A native dog of Australia, *Canis lupus dingo*.
- dinoflagellate** A unicellular protist (whirling alga) that has two flagella: one transverse flagellum encircling the cell, which provides spinning motion, and one posteriorly directed flagellum that steers the cell; it includes zooxanthellae and toxic species that cause red tides.
- dinosaur** An extinct archosaurian; a name meaning 'terrible lizard'; the dominant vertebrates of the Mesozoic era including large animals up to 30 m long; *see* Archosauria.
- dioecious** An organism in which sperm and eggs are produced by separate individuals.
- dipleurula** A type of free-swimming larva, bilaterally symmetrical and with winding bands of cilia; for example, in echinoderms.
- diploblastic** In an animal, having two cell layers.
- diploid** An organism that carries two sets of chromosomes (2n), one set derived from each parent.
- diplomonad** An unicellular, heterotrophic flagellate (a protist); it has two nuclei each associated with a pair of flagella; a gut parasite such as *Giardia*.
- diplontic** A life cycle where only the gametes are haploid (e.g. humans).
- diprotodont** A marsupial with only one pair of incisors in the lower jaw.
- direct development** Development in which an animal is born with the general form of the adult.
- disaccharide** Two monosaccharide molecules joined by a glycosidic bond.
- distal convoluted tubule** The part of the vertebrate nephron located after the proximal convoluted tubule (and loop of Henle in mammals and birds), responsible primarily for reabsorption of solutes but not water; it is sometimes called the diluting segment.
- distribution** Where a species occurs geographically.
- disturbance** Environmental fluctuations that affect biological communities (e.g. cyclones and fire).
- divergent evolution** Evolution that leads to descendants becoming different in form from their common ancestor.
- $\alpha$ -diversity** The concept of the diversity of a biological community within a local area that takes account of the relative abundance of species.
- $\beta$ -diversity** A measure of the diversity among different biological communities in different habitats in spatially separate areas.
- DNA hybridisation** The process whereby two DNA strands from different sources form a double-stranded DNA molecule through complementary base pairing; DNA strands require complementary sequences to be able to hybridise with each other.
- DNA ligase** An enzyme that joins the 3' hydroxyl and 5' phosphate ends of DNA strands by catalysing the formation of a phosphodiester linkage.
- DNA polymerase** An enzyme that catalyses the replication (template-dependent synthesis) of DNA by the addition of nucleotides to a growing strand of DNA in a 5' to 3' direction.
- dolipore septum** A septum with a complex pore separating adjacent cells in the hyphae of basidiomycete fungi.
- domain** The level of super kingdom used in the classification of living organisms.
- domatia** The specialised structures in plants that house animals such as ants.
- dominance relationship** The physical domination of one individual over another; it is usually established by aggressive behaviour and once established the relationship remains stable without subsequent high levels of aggression.
- dominant** A homozygous phenotype, such as yellow colour in seeds, that appears in a heterozygous (*Yy*) organism.
- dominant oncogenes** A mutated version of a normal cellular gene that is overexpressed, misexpressed or produces an altered product to cause tumour formation.
- donor DNA** DNA that is to be cleaved into segments, ligated into a vector and transformed to produce cloned DNA segments.
- dormancy** A resting condition with reduced metabolic rate (e.g. mature seeds before germination).
- dormant** A state of a mature seed that does not result in germination as a result of rehydration but is broken more by periods of cold or exposure to appropriate levels of red light.
- dorsal lip of the blastopore** A region of the blastopore which, in amphibian embryos, initiates gastrulation and induces formation of a dorsal-ventral axis.
- dorsal nerve cord** A hollow nerve cord above the notochord of chordates and which controls body movement.
- dorsiventral** Leaves in which the upper and lower mesophyll sections have a distinctly different anatomical arrangement of the cells.
- drag** A backward component of force acting on a moving body produced by a fluid resistance.
- drupe** Fleshy fruit, such as a plum, containing a single seed enclosed in a hard stony layer (endocarp).
- dryland salinity** The rise of a water table bringing salt to the soil surface in dryland regions.
- duplex** A double stranded (base paired) stretch of DNA.
- dynamic instability** The dynamic nature of microtubules, which frequently grow by polymerisation or shorten by depolymerisation within a cell.
- ecdysis-triggering hormone (ETH)** Peptide hormone which stimulates excitability of neurons producing the eclosion hormone and unlocks the sequence of behaviours that precede moulting.
- ecdysone** An insect hormone, secreted by the ecdysial glands, which stimulates moulting, growth and differentiation of adult tissues.
- Echinodermata** A phylum of deuterostome animals that includes feather stars, sea urchins, sea stars, brittle stars and sea cucumbers.
- Echinoidea** A class of echinoderms that includes sea urchins and sand dollars.
- eclosion hormone** A peptide hormone that promotes moulting in insects by stimulating the release of eclosion hormone.
- ecological pyramid** Of numbers, biomass or energy; a diagram showing the change in energy, biomass or numbers of organisms at successive trophic levels in an ecosystem.
- ecologically sustainable development (ESD)** Using, conserving and enhancing resources so that ecological processes in ecosystems are maintained.
- ecology** The study of interactions between organisms and their environment.
- ecosystem** An ecological community together with the physical environment with which its members interact.
- ecotone** The boundary between two different ecological communities.
- ectoderm** The outermost germ layer of animal embryos, giving rise to the outer body covering and neural tissue.
- ectoparasite** A parasite that lives on the surface of its host.
- Ediacaran fauna** The fossil traces of a collection of soft-bodied animals dated at 640–680 million years old; the best evidence that animals had evolved in the Precambrian; found on all continents.
- egg** Female gamete.
- eicosanoids** A diverse group of hormones produced by a wide variety of tissues, released in response to local stimuli and acting on neighbouring cells at extremely low concentrations.
- El Niño** An extreme weather event of dry conditions when there is major disruption of normal air and oceanic circulation in the Pacific region.
- elaioplast** Plastid in which oil is stored.
- elastin** The structural protein of the extracellular matrix that is unusual because it remains in an unfolded, random coil configuration.

- elater** An elongated water-absorbing cell with helically arranged wall thickenings; as elaters dry, they move and flick spores from spore capsules of liverworts and hornworts.
- electrical gradient** The difference in electrical voltage between two regions, for example across a membrane.
- electrical potential** The tendency to donate or accept electrons.
- electrical synapse** A contact between two neurons where the membranes fuse, which allows electrical signals to conduct from one cell to the other.
- electrocardiogram (ECG)** Electrical activity from the heart that can be measured with electrodes on the body surface; the sequence of cardiac events can be interpreted from changes in electrical potential between the electrodes.
- electrochemical gradient** The combined concentration and electrical gradient along which ions diffuse across a membrane, provided the appropriate ion-selective channel is present and open.
- electron** A subatomic particle that is negatively charged; it orbits the nucleus of an atom.
- electron transport pathway (electron transport system)** A group of membrane-bound enzymes and cofactors, which operate sequentially in a highly organised manner.
- element** A substance made up of only one type of atom with the same atomic number.
- elephantiasis** A grotesque swelling of lymphatic tissue caused by the tropical nematode parasite *Wuchereria bancrofti*.
- elimination** The loss of undigested and unabsorbed food from the digestive tract (not to be confused with excretion).
- embryo** A developing organism.
- embryo sac** The female gametophyte of flowering plants typically containing seven cells and eight haploid nuclei.
- embryonic stem cell** An undifferentiated embryonic cell that has the potential to proliferate and give rise to all differentiated cell types.
- emigration** Movement out of a population.
- encephalisation** The evolutionary process whereby neurons aggregate towards the anterior end of the body to form cerebral ganglia and brains.
- endarch xylem** A pattern of primary xylem development in which new xylem is added to the outside of the protoxylem in stems of plants.
- endemic species** A species that is unique to a specific geographic region; it is assumed to have evolved there.
- endergonic** A reaction in which the change in free energy is positive; energy is needed for the reaction to proceed.
- endocarp** The innermost layer of a fruit.
- endocrine gland** The gland of internal secretion; it usually secretes into the circulatory system.
- endocrine hormone** A hormone released into circulating blood (or haemolymph) and which exerts its effects on distant cells.
- endocytosis** The process of invagination of the plasma membrane to form a vesicle containing extracellular material that is transported into the cell.
- endoderm** In animals, the innermost germ layer; it lines the archenteron and gives rise to the lining of the lungs and the epithelial mucosa of the gut and associated glands.
- endodermis** In plants, the layer of cells immediately outside the pericycle of a root; it regulates the uptake of water and solutes into the central vascular cylinder by means of the Casparian strip.
- endolysosome** An intermediate, membranous compartment between the Golgi apparatus and the lysosome.
- endomembrane system** The membranes inside a cell including the endoplasmic reticulum, Golgi apparatus, lysosome and vesicles.
- endoparasite** A parasite that lives internally in its host.
- endoplasmic reticulum (ER)** A network of membranous sacs (cisternae) extending throughout the cytoplasm of a eukaryotic cell; it is usually flat and sheet-like but can be linked by tubular cisternae.
- endopodite** One of the two parts of a biramous appendage of a crustacean.
- endopterygotes** Insects that have complete metamorphosis; the developing wings are not visible in juvenile stages (larvae and pupae).
- endoskeleton** A skeleton that is inside the body, as in the vertebrates.
- endosome** A membrane-bound compartment that processes material taken up by endocytosis before transfer to lysosomes for degradation.
- endosperm** Triploid nutritive tissue in the seeds of angiosperms.
- endospore** A bacterial cell (spore) that is highly resistant; it is virtually metabolically inactive and able to survive high temperatures and many chemicals, even disinfectants.
- endosymbiosis** An organism living inside another; the theory of the origin of chloroplasts and mitochondria of eukaryotes from a host cell engulfing a bacterium (primary endosymbiosis) or another eukaryote (secondary endosymbiosis).
- energy** The capacity to do work; it exists in a number of forms, including chemical, heat, sound, electricity and light.
- energy quantum** The energy required to move an electron from one orbital to another.
- enhancer** A sequence in a eukaryotic gene that binds transcription factors that increase transcription.
- enteric nervous system** The division of the autonomic nervous system that controls the functions of visceral organs.
- enteroreceptor** A sensory receptor inside the body that senses the internal state of an animal.
- entropy** The measure of disorder (randomness) in a system; energy becomes lost as heat in every energy conversion, resulting in increased entropy.
- enzymatic digestion** All digestion relies on enzymes, but enzymatic digestion distinguishes digestion resulting from enzymes produced by the animal's own cells as opposed to digestion by microbial fermentation.
- enzyme** The biological catalyst, usually a protein, which increases the rate of a reaction.
- eosinophil** A blood cell often associated with asthma but also important in defence against parasites.
- Epacrid sclerophyllous** Heath plants in the family Ericaceae.
- Ephyra** (pl. ephyrae) The small medusae produced asexually in the life cycle of a jellyfish.
- epiboly** The spreading and/or overgrowth of one cell layer by another layer during gastrulation.
- epicotyl** The growing meristem or shoot of a germinating seed that lies above the cotyledons.
- epidermis** The outer cellular layer of a multicellular organism.
- epigeal germination** Germination in which the cotyledons emerge above the ground.
- epigenetic regulation** Inherited states of activity of a gene, independent of the genotype.
- epigynous** A flower with an inferior ovary that is buried within the receptacle below the perianth.
- epiphyte** A plant that grows on another plant for support, but is not parasitic.
- epiphytotic** A fungal disease epidemic on plants.
- epistasis** The masking of the phenotype of one gene by the phenotype of a different gene.
- epithelial to mesenchymal transition** The process by which an epithelial cell that has adhered to neighbouring cells detaches and adopts a migratory morphology.
- epithelium** The tissue that forms a continuous layer covering internal or external surfaces of most multicellular organisms.
- epitope** The portion of an antigenic molecule that is recognised by an antibody or T cell receptor; a large protein may have hundreds of different epitopes.
- epsp** (excitatory post synaptic potential) An excitatory change in the membrane of a postsynaptic neuron caused by chemical or electrical signals from a presynaptic cell.
- Epstein-Barr virus** The cause of glandular fever.
- equilibrium constant** The description of the equilibrium position of a chemical reaction;  $K_{eq} = \text{concentration of product(s)}/\text{concentration of reactant(s)}$ .
- equilibrium** Of a chemical reaction; when there is no net change in the concentration of either reactants or products.
- erosion** The loss of soil by the action of wind or water.

- erythrocrucorin** The respiratory pigment of annelid worms; a type of haemoglobin.
- erythrocyte** A mature, anucleate red blood cell; it contains haemoglobin.; in adult mammals it is anucleated.
- erythropoietin** A glycoprotein hormone produced by the kidney in response to low oxygenation of the blood; it stimulates erythropoiesis.
- ester** Formed from combining an acid and alcohol with the loss of water.
- ethics** A code of conduct.
- ethology** The study of animal behaviour.
- ethylene** C<sub>2</sub>H<sub>4</sub>; A gas of low molecular mass, influencing a wide range of processes in plant development, including promoting fruit ripening, shoot growth and flower senescence.
- etioplast** A plastid that develops in darkness and which, on exposure to light, develops into a chloroplast.
- euchromatin** Lightly staining regions in an interphase nucleus; it consists of dispersed strands of chromatin that are sites of active gene transcription.
- euclids** The core group of dicotyledonous flowering plants that are a monophyletic group.
- euglenoid** A single-celled marine or freshwater flagellate; the photosynthetic forms probably acquired their plastid from engulfing green alga.
- Eukarya** The super kingdom (or domain) that includes all eukaryote organisms—plants, fungi and animals.
- eukaryote** Protists, fungi, animals and plants; cellular organism with membrane-bound organelles such as a nucleus, mitochondria and chloroplasts.
- eukaryotic cell** A cell with a nucleus and other membrane-bound organelles; *compare* prokaryotic cell.
- Eumetazoa** The subkingdom of animals, except sponges.
- euryhaline** Able to tolerate a broad range of salinities.
- eusociality** A social grouping in which individuals co-operate in raising young; essentially sterile workers care for the young of reproductively active individuals (reproductive division of labour).
- eutelic** The condition of having a set number of cells, for example in nematodes after hatching mitosis does not occur.
- Eutheria** A major group of mammals, so-called placentals.
- Eutheria** One of the three subclasses of mammals; the so-called placental mammals.
- evaporation** The loss of water molecules as a vapour from a surface.
- evapotranspiration** The combined process of transpiration of water from plants or direct loss by evaporation from soil.
- evolution** The process of change and divergence in populations and taxa.
- evolutionarily stable strategy** A strategy (or behaviour) that, if adopted by most members of a population of interacting individuals, cannot be bettered (in terms of reproductive success) by another strategy or behaviour.
- evolutionary tree** A representation of the branching evolutionary links between species over time.
- exarch xylem** The pattern of xylem development in roots in which the xylem forms from the outside, filling the centre of the root.
- excretion** The loss of ions, solutes, metabolic waste products or water from body fluids; not to be confused with elimination.
- exergonic** A reaction when the change in free energy is negative; energy is released in the reaction.
- exine** The outer patterned layer of pollen grains.
- exocarp** The outermost layer of a fruit, for example the skin of a peach.
- exocrine gland** A gland of external secretion.
- exocytosis** The fusion of a vesicle with the plasma membrane, expelling its contents from the cell.
- exodermis** The layer of suberised cells at the junction of epidermis and cortex of certain roots; it regulates uptake of water, solutes and ions into the cortex.
- exon** A segment of RNA that remains in the mRNA following splicing.
- exonuclease** An enzyme that cuts DNA by removing bases sequentially from the ends of DNA strands by hydrolysing terminal phosphodiester bonds.
- exopodite** One of the two parts of a biramous appendage of a crustacean.
- exopterygote** An insect that has an incomplete metamorphosis; developing wings are visible in nymphs.
- exoskeleton** The external hard body covering of some animals.
- experimental control** In an experiment, a variable to be tested is altered in one trial and compared to a second trial (the control) where the variable is left unaltered.
- exponential growth** Population growth in which the size of the population regularly doubles; population size thus increases rapidly (geometrically).
- expressivity** The degree to which an allele is expressed phenotypically in an individual.
- exteroceptor** A sensory receptor that senses the world outside the body of an animal.
- extracellular compartment** That part of the body fluid that is located outside of the cells; it includes fluid located between cells, the plasma component of the blood, intra-ocular fluid and fluid in the gut.
- extracellular matrix** Forms the extracellular environment of animal cells; a fluid matrix containing an extensive network of proteins and polysaccharides linked together by covalent and non-covalent bonds that fills the spaces between cells.
- F<sub>1</sub> progeny** The progeny of a cross between two pure-breeding individuals.
- F<sub>2</sub> progeny** The progeny of a cross between F<sub>1</sub> progeny.
- facilitated diffusion** The passive movement of molecules across a membrane in which transport by membrane-spanning carrier proteins enables faster movement of molecules than by the diffusion gradient alone.
- family** A higher level taxon (grouping) used in classification of organisms; above genus.
- fatty acid** A hydrocarbon chain with a carboxyl group at one end; a component of many lipids.
- feather** A modified scale characteristic of birds; feathered wings allow flight.
- fecundity** The probability of giving birth.
- female choice** A mechanism of sexual selection, in which females show a preference for males according to secondary sexual characteristics.
- feral animal** A domestic animal or animal introduced to control a pest or for recreation that has gone wild.
- fermentation** The anaerobic production of alcohol, lactic acid or similar molecules from carbohydrates by the glycolytic pathway.
- fern** *See* Filicophyta.
- fertilisation** The specific interaction between an egg and sperm leading to formation of a zygote.
- fibre** Cellulose and pectins of plant cell walls, which are not easily digested and which form bulk in the diet; an elongated and tapered sclerenchyma cell with a secondary wall, with or without lignin.
- fibrin** Protein strands created from the plasma protein fibrinogen that form the meshwork over a wound to initiate a blood clot.
- fibrinogen** A soluble blood plasma protein that is converted to insoluble fibrin strands by the action of the enzyme thrombin; involved in blood clotting.
- fibronectin** An adhesive protein of the extracellular matrix occurring in interstitial matrices; it has a high relative molecular mass (about 460 kD) and two polypeptide chains.
- fibrous protein** Proteins that have a high proportion of hydrophobic R-groups, are insoluble in water and have high tensile strength, for example keratins and silks.
- Filicophyta** A phylum of ferns; the most diverse group of living vascular land plants that reproduce by spores.
- filter feeder** Animals that obtain food by straining suspended matter from a volume of water, usually by passing the water over specialised structures such as the baleen plates of some whales.
- filtration** The loss of fluid through holes in capillary walls (or membranes) due to hydrostatic pressure; water and small dissolved substances move through but large proteins and blood cells remain.

- first law of thermodynamics** Energy can be neither created nor destroyed; energy can be transformed from one form to another but the total energy of the universe remains constant.
- fitness** Biological success as measured by an individual organism's contribution of offspring to the next generation.
- flagella** Long, thin extensions of cytoplasm that result in non-muscular locomotion when a wave of bending travels from the tip of a long flagellum to its base, or base to tip, forcing water in the opposite direction.
- flame cell** A cell of excretory organs, protonephridia, found in flatworms and annelids.
- fleshy finned fishes** Coelacanths and lungfishes.
- florigen** A hypothetical plant hormone that promotes flowering.
- flower** The sexual reproductive structure of angiosperms; comprises four whorls or layers—sepals, petals, stamens (male organs) and carpels (female organs).
- fluid mosaic** Describes cell membranes; fluidity referring to the lateral movement of lipid molecules, and mosaic referring to the irregular arrangement of proteins.
- foliose** Leaf-like, describing some types of lichen.
- follicle** A dry simple fruit from one carpel and which opens on the lower side (e.g. banksias and grevilleas).
- follicle cell** Also known as granulosa cells; somatic cells that surround the maturing oocyte and serve a protective and nutritive function.
- food chain** A sequence of organisms from producer to consumers along which energy flows in an ecosystem; usually with three or four trophic levels.
- food web** A number of interacting food chains in an ecosystem.
- foraging theory** The evaluation of the costs and benefits associated with particular foraging behaviours, in order to predict which behaviours might be expected under different circumstances.
- foram** A marine protist that produces a calcareous shell (a test); the shells house endosymbiotic algae.
- foregut fermentation** The digestion of foodstuffs (largely cellulose) by symbiotic microorganisms located anterior to the true stomach.
- fossil** The preserved remains of an organism or traces of it, such as footprints (trace fossil) or chemical compounds produced by it (chemical fossil).
- fossil cast** A fossil mould filled by material such as silica or phosphate forming a three-dimensional cast of the remains of an organism.
- fossil mould** An impression in a rock of the remains of an organism that have been dissolved away.
- frameshift mutation** A mutation that removes or adds a number of nucleotides not equal to multiples of three (i.e. mutations that disrupt the normal sequence of codons).
- free energy (G)** The usable energy in a chemical system.
- frond** A fern leaf.
- fructose** A monosaccharide (sugar) that is a structural isomer of glucose.
- frugivore** A fruit-eating animal.
- fruit** The mature ovary of a flowering plant; contains seeds; may be dry or fleshy; simple (from one carpel), aggregate (from a cluster of separate carpels on one flower) or multiple (from a cluster of many carpels from different flowers).
- frustule** Valve or silica dish, two of which make up the cell wall of a diatom; the two valves of a cell are interconnected by silica hoops (girdle bands) to create frustules.
- fruticose** A type of lichen with loosely attached leaf-like structures.
- fucoxanthin** An accessory photosynthetic pigment found in the chloroplasts of chrysophytes (golden flagellates).
- fuel molecule** A molecule such as a carbohydrate and fat with energy-rich chemical bonds that are broken down to give energy.
- functional group** Of biomolecules; a combination of atoms whose characteristic behaviour is maintained no matter which molecule they are attached to.
- fundamental niche** That region of the environment within which a species can persist indefinitely; defined by all the abiotic and biotic factors that impinge on the survival and reproduction of the species.
- fungus** (pl. fungi) An eukaryote with cell walls, lacks chlorophyll and absorbs its food (e.g. moulds, yeasts, mushrooms, etc.).
- fungi imperfecti** Phylum Deuteromycota of fungi, which includes those not known to reproduce sexually.
- fusiform initial** A type of meristematic cell produced by the vascular cambium differentiating into secondary xylem and secondary phloem cells.
- G1 phase** The first gap phase; the period between completion of mitosis and the onset of DNA replication (S phase).
- G2 phase** The second gap phase; the period between the completion of DNA replication (S phase) and the onset of mitosis.
- gait** A characteristic pattern of locomotion.
- game theory** A mathematic technique used to examine the relative costs and benefits of different behaviours, when the outcome of the behaviour depends upon what other individuals are doing; it is commonly used in economics.
- gametangia** A structure that produces gametes, for example in fungi.
- gametes** The mature male and female germ cells that fuse to form the zygote.
- gametocyte** A cell type in the life cycle of the malarial parasite *Plasmodium*; a stage ingested by mosquitoes feeding on host blood; it develops into sperm and eggs in the mosquito's gut.
- gametogenesis** The formation of the gametes.
- gametophyte** The haploid stage of a plant life cycle that produces gametes.
- ganglion** (pl. ganglia) An organised group of neurons.
- gap gene** A gene expressed in and required for formation of a group of segments.
- gas bladder** An outgrowth of the alimentary tract found in some fishes that originally evolved for buoyancy but can also be used for gas exchange.
- gastrin** A non-neural endocrine hormone that is released by the stomach lining and stimulates the release of HCl.
- gastropod** A mollusc of the class Gastropoda, including snails and nudibranchs.
- gastrovascular cavity** See coelenteron.
- gastrula** The embryonic stage during which gastrulation is proceeding.
- gastrulation** The large scale reorganisation and movement of cells, following cleavage, during which the three germ layers form and bilateral symmetry appears.
- gating** The release of a hormone only at a particular time in the circadian cycle.
- gemma** (pl. gemmae) An asexual reproductive structure (propagules) of liverworts; formed in gemmae cups on the surface of thalloid forms; dispersed by splashes of rainwater.
- gene duplication** The duplication of a segment of DNA within a genome; it enables organisms to produce different (but related) forms of a protein, each adapted to function efficiently in particular circumstances.
- gene family** Genes that exhibit sequence similarity and characteristically encode proteins that have related biochemical functions.
- gene tree** The representation of the branching evolutionary links between genes over time.
- generation of diversity** The process of differentiation of lymphocytes in the bone marrow or thymus leading to the ability of each lymphocyte to recognise a different antigen.
- generative cell** The male reproductive cell of a pollen grain, formed by asymmetric cell division of the microspore and lies entirely within the vegetative cell; the progenitor of the sperm cells.
- genes** The discrete hereditary factors that determine traits.
- genetic marker** A genetic-based phenotype that enables a population to be characterised genetically.
- genetic modification** Changing the genetic make-up of an organism through the introduction of new genetic material.
- genome** The sum of the genetic material of a cell or organelle.
- genomic equivalence** The cells of the same organism having the same genes, although they

- may be differentially expressed in different tissues.
- genomic library** A collection of cloned genomic DNA fragments; normally consist of a large number of random genomic fragments, each cloned into a vector and propagated separately as individual plaques or colonies, each carrying one of the random genomic fragments.
- genotype** The particular combination of alleles of an organism.
- genotypic frequency** The frequencies of particular genotypes in a population
- genus** (pl. genera) A taxon (grouping) above the level of species; designated by the first word of the species binomial (which is a Latin name).
- germ cell** The line of cells that gives rise to gametes.
- germ layers** The three basic tissue layers formed during gastrulation—endoderm, mesoderm and ectoderm.
- germination** The beginning or resumption of growth by a spore, seed, bud or other structure.
- gestation** The state of being pregnant, when the adult carries within its body the developing embryo(s).
- gibberellic acid** GA<sub>3</sub>, the best studied of the gibberellins, a class of plant hormones.
- gibberellins** A class of plant hormones promoting stem elongation and seed germination; composed of small molecules each containing 19 or 20 carbon atoms; synthesised in the shoot and germinating seeds.
- gill** An outgrowth of the body surface used in gas exchange.
- Ginkgophyta** A phylum of seed plants that includes only one living genus, *Ginkgo*.
- girdle** A site of the transverse flagellum that encircles a dinoflagellate cell.
- glacial period** A cold dry period associated with low sea-level (e.g. during the Pleistocene period); glaciers formed in parts of the world.
- glaucophyte** A photosynthetic flagellate with a plastid, termed a cyanelle, which has a peptidoglycan wall, as do bacteria.
- glial cell** A supporting cell of the nervous system; provides insulation, and mechanical and nutritional support for neurons, and guides their development and repair.
- gliding** A form of unpowered flight; muscles in gliding animals may be active to maintain a particular posture (such as outstretched wings), but they do not generate work.
- global cycle** The cycling of material through ecosystems on a global (world) scale; involving the atmosphere (e.g. carbon).
- global warming** An increase in the average temperature of the earth's atmosphere, occurring because of an increase in greenhouse gases.
- globular protein** One type of protein shape created by the folding of the backbone so that the hydrophobic side chains are buried in the interior of the molecule away from contact with water.
- glochidium** A type of veliger larva of some bivalve molluscs that can grip onto and parasitise fish.
- glomerulus** A spherical tuft of capillaries associated with the vertebrate nephron; filtration of fluid from the glomerular capillaries forms the primary filtrate.
- glomus cell** A cell containing a variety of neurotransmitters that is found in the carotid body and is in close proximity to capillaries and nerve endings; it primarily responds to changes in the partial pressure of oxygen hence assisting in the control of ventilation.
- glucagon** A hormone released by alpha pancreatic islet cells; it causes increased blood glucose levels due to breakdown of glycogen and synthesis of glucose from amino acids.
- glucocorticoid** A steroid hormone produced in the adrenal cortex which promotes gluconeogenesis.
- gluconeogenesis** A synthesis of glucose from non-carbohydrate sources such as amino acids.
- glucose** A carbohydrate (monosaccharide) that is the initial sugar product of photosynthesis; a building block of cellulose.
- glycemic index (GI)** A classification of foods based on their ability to raise blood glucose; the measurement is made on a portion containing an identical amount of carbohydrate and standardised against white bread or pure glucose.
- glycocalyx** Carbohydrate chains on the outer surface of the plasma.
- glycogen** A polysaccharide that serves as the principal storage form of carbohydrate in animals.
- glycolipid** A lipid with a short chain of sugar residues; in membranes, it occurs on the non-cytosolic side.
- glycolysis** An anaerobic catabolism of glucose to pyruvic acid, producing two molecules of ATP.
- glycophyte** A plant species that cannot grow on salt-affected soil.
- glycoprotein** A chain of sugar molecules attached to protein; it occurs on the non-cytosolic side of plasma membranes.
- glycosaminoglycans** Large polysaccharide molecules composed of repeating disaccharide units, usually linked to a protein core; they are a major component of the extracellular matrix and are responsible for gel hydration.
- glycosidic linkage** The linkage between two monosaccharides in their cyclic form to make a disaccharide.
- glyoxysome** A microbody that contains the five enzymes of the glyoxylate pathway; it is involved in the breakdown of fats.
- Gnathostomata** See vertebrate.
- Gnetophyta** A phylum of seed plants that includes only three living genera thought to be related to the angiosperms; includes *Gnetum*, *Ephedra* and *Welwitschia*.
- goitre** An enlargement of the thyroid gland caused by lack of iodine in the diet.
- Golgi apparatus** Stacks of four to ten disc-shaped cisternae functioning in synthesis of polysaccharides, glycosylation of proteins and the sorting of molecules for storage or secretion.
- gonad** The testis or ovary.
- gonangium** (pl. gonangia) An individual in a colony of hydrozoan polyps that functions in reproduction.
- Gondwana** The past supercontinent uniting all southern land masses.
- G-protein** (guanosine triphosphate-binding protein) An intermediate molecule in many cellular signalling pathways; they alter the activity of ion channels or intracellular enzymes.
- G-protein-linked receptor** A receptor that when activated forms a complex with, and acts through, a G-protein to modify ion channel or intracellular enzyme activity.
- Gram stain** A stain made from crystal violet and iodine that is used to identify particular types of bacteria; Gram-positive species stain purple and Gram-negative stain pink.
- grana** Stacks of thylakoids that form part of the internal membrane system of chloroplasts.
- granulocyte** A leucocyte produced in bone marrow that migrates to sites of infection, where it engulfs and kills foreign organisms.
- graptolite** Extinct colonial animals with skeletons of chiton, known from the Cambrian.
- gravid** Filled with eggs.
- gravitropism** The response of a root or shoot to the pull of gravity.
- grazing food chain** A food chain directly dependent on plants.
- green alga** Chlorophyte; a unicellular, colonial and multicellular alga of fresh and marine water; green due to presence of chlorophyll *a* and *b* pigments, as with land plants.
- green bacteria** A type of photoheterotrophic bacteria that uses sunlight for energy but ready-made organic compounds as building blocks; comprise a characteristic set of photosynthetic pigments different from plants.
- greenhouse effect** The natural warming of the earth by heat trapped due to the presence of certain heat-absorbing gases in the atmosphere.
- growth** An irreversible increase in the dry mass of an organism.
- guanotely** The pattern of nitrogenous waste excretion where excess nitrogen (mainly from digested protein) is excreted as the purine, guanine.
- guard cells** A pair of kidney-shaped cells regulating stomata.
- gullet** An anterior depression where flagella emerge in euglenoid cells; food may be ingested through the gullet in some species.
- gynoeceium** The carpels of a flower.
- habitat corridor** The linking of adjacent fragments of vegetation and species populations.
- habitat fragmentation** The loss of natural habitat that separates and isolates (fragments) species populations.

- habitat selection theory** The idea that all individuals of a species attempt to live in places that maximise their chances of survival and reproduction (their evolutionary fitness).
- haemagglutinin** The type of protein; for example a surface protein in the lipid outer membrane of the 'flu' virus.
- haematocrit** The volume fraction of whole blood occupied by the blood cells.
- haematopoietic stem cell** A stem cell that can give rise to all of the different types of cells of the haematopoietic (blood cell) system.
- haematopoietic stem cell** Progenitor cells in the bone marrow which give rise to all blood cell types.
- haemocoel** Large spaces in the body that are filled with blood.
- haemocyanin** Copper-containing respiratory pigment found in arachnids.
- hair** In mammals, the thread-like outgrowth of the skin derived from scales; in plants, a trichome.
- half-life** The time taken for half of the atoms of a radioactive sample to decay.
- halophile** A bacteria (Archaea) that survive in highly saline environments (salt-loving).
- halophyte** A plant adapted to saline environments.
- halter** A mobile knobbed rod of flies; a modified wing that assists with balance during flight.
- haplodiplontic** A life cycle where meiosis produces haploid spores that give rise to gametes subsequently following one or more mitotic divisions (e.g. flowering plants).
- haploid** A cell possessing only one set of chromosomes ( $n$ ), as in egg or sperm.
- Haplorhini** Tarsiers, monkeys, apes and humans; primates that lack a rhinarium (nose pad), which is replaced by a nose with nostrils that are usually rounded in shape.
- haptonema** A thread-like extension between the two flagella of a haptophyte (protist), which can bend or coil, capturing prey.
- haptophyte** Flagellated, photosynthetic protistan cells that are extremely abundant in oceans.
- Hardy–Weinberg frequencies** The frequencies of genotypes expected for given allele frequencies in an infinitely large interbreeding population in which there is random mating but no migration, mutation or selection.
- Hartig net** A mycorrhizal fungus mycelium that grows between root cortical cells facilitating nutrient transfer.
- haustoria** The end of a fungal hypha that absorbs nutrients from a host cell.
- heartwood** A mature secondary xylem, in which the rays have degenerated, and the vessels and tracheids are filled with secondary organic compounds that make the wood hard and durable.
- helper cells (T<sub>H</sub> cells)** Regulatory T cells that produce and secrete lymphokines.
- Hemichordata** A subphylum of chordates; acorn worms.
- hemidesmosome** The junction formed by cross-linking between the cytoskeleton of a cell and the extracellular matrix; it provides structural support by anchoring cells to the matrix.
- hemizygous** A gene present in only one copy in a diploid organism, for example, a gene on the X chromosomes of a male.
- Hepatophyta** A phylum of liverworts, including thalloid and leafy forms.
- herbicides** Chemical or biological agents which kill plants or inhibit their growth.
- herbivore** An animal that consumes algae or plants as food.
- hermaphrodite** A type of animal in which both male and female reproductive organs occur within the same individual (also called monoecious); a type of plant in which the flowers contain both male and female organs.
- hermaphroditism** Having both male and female sex organs in the one individual.
- herpes simplex virus** A virus that infect the lips and genital regions of humans.
- heterochromatin** The densely staining regions in an interphase nucleus; it consists of aggregated strands of chromatin that are inactive in gene transcription.
- heterocyst** The specialised cell of a cyanobacterium; the colourless, thick-walled cell that is a site for nitrogen fixation and may be involved in asexual reproduction.
- heterokaryon** The multinucleate vegetative cell of a fungus where the nuclei are genetically different.
- heterokont** The protist characterised by one smooth flagellum directed posteriorly and one hairy flagellum directed anteriorly.
- heterospory** Having two types of spore; heterosporous plants develop separate male and female gametophytes.
- heterothallic** Sexually incompatible, for example in fungi.
- heterotroph** An organism that consumes other organisms as food; unable to synthesise organic molecules from inorganic compounds.
- heterotrophic** The obtaining of chemical energy by consuming other organisms or by degrading their organic molecules; heterotrophic organisms include animals and fungi.
- heterozygous** The organisms in which the alleles are different, for example  $Yy$ .
- hexacanth** A six-hooked larva of a tape worm that hatches from the egg; it is able to penetrate the gut wall of a host animal; it is also called an onchosphere.
- hibernation** A period of inactivity and reduced metabolic rate that is usually induced by cold; observed in ectotherms and endotherms.
- high-energy bond** In ATP, bonds that can be used to release energy to drive reactions.
- hindgut fermentation** The digestion of foodstuffs (largely cellulose) by symbiotic microorganisms located posterior to the true stomach.
- hirudin** An anticoagulant protein produced by leeches; it specifically inhibits the blood-clotting factor thrombin.
- histone** A basic protein that interacts strongly with DNA; it aids the formation of nucleosomes in nuclei of eukaryotic cells.
- holdfast** The part of the thallus of a brown alga that attaches it to the substrate.
- holomorph** The anamorphic (asexual) and teleomorphic (sexual) forms of a fungus; entire forms of a fungus.
- Holothuroidea** A class of echinoderms; sea cucumbers.
- homeostasis** The maintenance of a relatively constant internal environment.
- homeotic (Hox) gene** A gene that is expressed in a restricted region of the anterior–posterior axis and determines the developmental fates of segments along the anterior–posterior axis.
- hominid** Human-like; it refers to fossil great apes that are related and in the same family (*Hominidae*) as modern humans.
- Hominidae** The family of great apes that includes modern humans and fossil hominid relatives.
- hominoid** Hominid-like; it refers to great apes.
- homokaryon** Multinucleate vegetative cell in fungi where the nuclei are genetically all the same.
- homologous chromosomes (homologues)** A pair of similar chromosomes in a diploid individual; one homologue is inherited from each parent.
- homologous** Structures that have the same basic plan but not necessarily the same function; used as evidence of phylogenetic relationship between organisms.
- homologous genes** Genes that share sequence similarity; presumably due to descent from a common ancestral gene.
- homospory** A haplodiplontic life cycle where all gametes are produced by one type of spore (e.g. most ferns).
- homothallic** Sexually compatible, for example in fungi.
- homozygous** Organisms in which the alleles are the same, for example  $YY$  or  $yy$ .
- hormone** A chemical messenger secreted by cells of an organism in response to specific stimuli; hormones modify the activity of cells as a result of interaction with specific receptors.
- hornwort** *See* Anthocerophyta.
- hot spot** The immobile point at the surface of the earth's mantle where a column of hot, upwelling asthenosphere rises, which may form islands.
- human immunodeficiency lentivirus (HIV)** *See* AIDS.
- humoral immunity** Immunity that depends on antibodies.
- Hyaluronan** A water soluble, linear polysaccharide in connective tissue; it forms clear gels.

- hydathode** A pore-like structure on the tip or margin of leaves of rainforest plants that permits water to be extruded when required by high root pressure.
- hydranth** An individual in a colony of hydrozoan polyps that functions in feeding.
- hydrated** Surrounded by molecules of water.
- hydrofoil** A structure that generates a lifting force when moving through a fluid.
- hydrogen bond** A relatively weak bond formed between hydrogen and another polar atom such as oxygen.
- hydrogen ion** An ion that forms in the dissociation of water,  $H^+$ .
- hydrolase** An enzyme that involves water in the breakdown of complex molecules to simple molecules.
- hydronium ion** In solution, hydrogen ions form mostly as  $H_3O^+$ .
- hydrophilic** The substances such as polar molecules that dissolve readily in water because they can readily form hydrogen bonds with water molecules.
- hydrophobic** The substances such as non-polar molecules that are insoluble in water because the hydrogen bonds between water molecules tend to exclude non-polar molecules.
- hydroponics** The cultivation of plants with, instead of soil, only a solution of mineral salts around the roots.
- hydrostatic pressure** The pressure exerted by a liquid, such as blood; a misnomer because the pressure can be exerted by liquids other than water, and the liquids can be moving.
- hydrostatic skeleton** A skeleton based on fluid-filled compartment(s) in the body of some invertebrates that lack stiff and strong skeletal structures; these animals are able to alter their body size and/or shape in order to move by exerting forces on the deformable fluid-filled compartments.
- hydroxyl ion** A negatively charged ion that forms with the dissociation of water ( $OH^-$ ).
- Hydrozoa** A class of cnidarians that has polyps as the dominant life stage; for example *Hydra*.
- hylids** A Gondwanan family of frogs (family Hylidae), including Australia's largest frog fauna.
- hyperglycaemic** Blood glucose raising.
- hyperosmotic** A solution which has a higher osmotic concentration than another.
- hyperpolarised** Increased voltage difference across a membrane; this moves membrane potential further from the threshold potential and therefore is inhibitory.
- hypersaline** Salt solutions that have a higher salt concentration than sea water.
- hyperventilation** An increase in the convective requirement for ventilation; that is, an increase in ventilation with respect to the rate of oxygen consumption.
- hypha** (pl. hyphae) A microscopic tube of cytoplasm bounded by a tough, waterproof cell wall; forms fungal mycelia.
- hypocotyl** The part of the axis of a germinating seed below the point of attachment of the cotyledons.
- hypodermic impregnation** Sexual reproduction in which a bundle of sperm is injected directly across the body wall; for example during copulation of some polychaete worms.
- hypogeal germination** Germination in which the cotyledons stay below the ground.
- hypoglycaemic** Blood glucose lowering.
- hypogynous** A flower with a superior ovary, that is, attached to or above the receptacle.
- hypo-osmotic** A solution that has a lower osmotic concentration than another.
- hypopharynx** Tongue-like projection behind the mouth of an insect.
- hypophysis** An alternative name for the pituitary gland.
- hypostome** The projection of a cnidarian polyp where the mouth is situated.
- hypothalamo-hypophyseal portal system** Portal blood vessels carrying blood between the capillaries of the median eminence and the capillaries of the anterior pituitary gland.
- hypothalamus** In vertebrates, the region in the midbrain surrounding the third ventricle; it receives information regarding the well-being of an animal and provides central neural and hormonal control of many functions.
- hypothermia** An unregulated decline in body temperature.
- hypothesis** A possible explanation for an observed phenomenon.
- hypoxia** Lower than normal levels of oxygen.
- icosahedron** A basic type of structure of virus particles where the protein shell has an arrangement of 20 sides.
- ideal free distribution** The distribution of animals between two resource sites; individuals are free to choose between the sites, and the distribution is ideal because each individual goes to the place that provides the highest returns.
- ideal population** A population that satisfies the Hardy-Weinberg population characteristics—an infinitely large interbreeding population in which there is random mating but no migration, mutation or selection.
- imago** The sexually developed adult stage of an insect life cycle.
- immigration** Movement into a population.
- immunisation** See vaccination.
- immunodeficiency** A deficiency in the immune response leading to repeated infections; it may affect B cells, T cells, phagocytic cells, antibody or complement.
- immunogen** Antigen that can stimulate an immune response.
- immunogenic** Able to stimulate an immune response.
- immunoglobulin (Ig)** Another term for antibody, referring to its protein structure.
- immunological memory** The retention of stimulated B cells or T cells, called memory cells; allowing a rapid immunological response to a subsequent interaction with the same antigen (secondary immune response).
- immunological tolerance** The acquired ability to ignore an immunogen; the induction of immunological tolerance to grafts is an immunologist's dream.
- immunopathology** Tissue damage induced as a side effect of the immune response.
- imprinting (behavioural)** Occurs when a newborn animal recognises the first moving object it sees (usually its mother) and follows it for the next few weeks; occurs usually during a limited period, the sensitive period.
- imprinting (genetic)** A 'marking' of a gene during gametogenesis that alters the activity of the gene in the offspring.
- imprinting** A 'marking' of a gene during gametogenesis that alters the activity of the gene in the offspring; it can produce different phenotypes in organisms with the same genotype; (behavioural) occurs when a newborn animal recognises the first moving object it sees (usually its mother) and follows it for the next few weeks; occurs usually during a limited period, the sensitive period.
- inbreeding** The preferential mating of related individuals.
- inclusive fitness** A concept in evolutionary biology that considers selection at the level of the gene, thereby incorporating the reproductive benefits an individual might accrue as a result of its behavioural interactions with relatives.
- incomplete dominance** The situation in which a heterozygote exhibits a phenotype that is intermediate between the homozygous phenotypes of the two alleles.
- incomplete metamorphosis** In more primitive insects, the gradual change in successive instars during development; compare complete metamorphosis.
- indirect development** Development that involves a larval stage followed by metamorphosis into the adult stage.
- indole-3-acetic acid (IAA)** Plant hormone; the main auxin occurring naturally in plants.
- induced fit** The change in shape of a protein when a substrate is bound to it.
- inducible gene** A gene that is only expressed in response to particular environmental conditions.
- induction** The process during embryogenesis whereby signals emitted from one group of cells induce a change in developmental fate of another group of cells.
- indusium** The protective leaf-like structure covering sori of some ferns.
- inflammation** The accumulation of phagocytic cells at the site of infection or other irritation.
- inflorescence** A cluster of flowers.

- influenza orthomyxovirus** The virus that causes the disease commonly called 'flu' (influenza); it infects the lungs and respiratory tract of humans.
- innate immunity** The inborn immune response which pre-exists encounter with an infection; *compare* acquired immunity.
- inner cell mass** A group of cells at one end of the mammalian blastocyst that contain embryonic stem cells and give rise to the embryo proper.
- insertion** A mutation that inserts one or more nucleotides into the DNA.
- instar** The juvenile stage between moults during the development of insects.
- insulin** A hormone released by alpha cells of the islets of Langerhans; it binds to membrane receptors and increases the membrane permeability to glucose and amino acids; it leads to increased storage of glucose and increased fat production.
- insulin-dependent diabetes mellitus (Type 1 diabetes)** It is characterised by high blood glucose concentrations and excretion of blood in the urine; it is caused by the destruction of the insulin secreting cells in the pancreas.
- integrated pest management** The co-ordinated use of various control techniques and integrating control with other activities to manage pest species.
- integration** The adding and subtracting of electrical signals arriving on the membrane of a neuron and resulting in an increase or decrease in its resting potential.
- integrin** Transmembrane glycoproteins that connect the actin filaments to the extracellular matrix.
- integument** The layer of cells surrounding megasporangium in seed plants; *see also* ovule.
- interferon** A group of proteins secreted by some virus-infected cells that assist uninfected cells to resist infection by that virus.
- intergenerational equity** The idea that future generations should enjoy an environment that is, at least, as healthy, diverse and productive as the one we presently experience.
- interglacial period** Warm periods with high sea-level that alternate with glacial periods; *see* glacial periods.
- interleukin** A cytokine that acts between leukocytes (white blood cells).
- intermediate disturbance hypothesis** The idea that a biological community has maximum species diversity when there is some (intermediate level) of disturbance such that no long-lived species is able to become dominant.
- intermediate filament** An element of the cytoskeleton of eukaryotic cells that is intermediate in size between microtubules and microfilaments; 8–10 nm in diameter; it provides mechanical support for the cell.
- interneuron** A neuron that transmits information from one neuron to another.
- internode** The portion of stem between successive nodes (site of leaf attachment).
- interphase** The period during which a cell is not undergoing mitosis; it comprises the G1 phase, S phase and G2 phase.
- interstitial matrix** A type of extracellular matrix prominent in connective tissues.
- intervertebral disc** Part of the skeleton of a tetrapod; the disc between adjacent vertebrae.
- intracellular compartment** That part of the body fluid that is located inside the cells of the body.
- intron** A segment of RNA that is removed from the primary transcript by splicing and is not present in the mature RNA.
- inulin** A water-soluble fructose polymer; plant storage polysaccharide; in dahlia tubers and artichokes.
- involucral bract** Small, leaf-like structures that surround a daisy head; *see* capitulum.
- involution** A process whereby groups of cells roll under their neighbours and move inwards, for example, during gastrulation of frog embryos.
- ion** An atom that loses or gains electrons, becoming positively or negatively charged.
- ion channel** The fastest enzyme known; it permits passive transport through cellular membranes; it is highly selective for particular ions; it is opened by a change in voltage across a membrane, or by binding with specific signal molecules.
- ionic bond** The bond formed when ions of opposite charge are attracted to each other.
- ionic compound** The chemical compound composed of anions and cations, bonded together by opposite charges.
- ionoconform** To have the same ionic concentrations in the body fluids as occur in the external medium.
- ionoregulate** To maintain body fluid ionic concentrations different from those of the external medium.
- ipsp (inhibitory post synaptic potential)** An inhibitory change in the membrane of a postsynaptic neuron caused by chemical or electrical signals from a presynaptic cell.
- irrigation salinity** Increased soil salinity due to rise in water table as a result of applying irrigation water to the land.
- isobilateral** Leaves in which palisade mesophyll extends from the upper surface to the lower surface.
- isomer** A variant of a molecule, with the same chemical composition but atoms arranged differently.
- isomerase** An enzyme that causes structural or geometric changes in substrate molecule.
- iso-osmotic** Two solutions with the same osmotic concentration.
- isotonic** Fluids that have the same potential to move water by osmosis across a semipermeable membrane, depending on the solute concentrations and the permeability of the membrane.
- jet propulsion** The ejection of a stream of particles (fluid or gas) in one direction that produces a force that propels the object expelling those particles in the opposite direction.
- joint** The part of an animal's body that (usually) permits movement between adjacent, rigid skeletal elements; the form of these articulations is quite varied, with some (e.g. hip joints) allowing large ranges of movement and others (e.g. teeth within tooth sockets) providing virtually none.
- jumping** A rapid acceleration of a body resulting in loss of contact with the substrate; in land animals, the force is usually generated by the muscle-powered extension of limbs or parts of the body.
- juvenile hormone** An insect hormone secreted by the corpora allata; it stimulates development of nymphal structures.
- juxtaglomerular apparatus** An association of structures (macula densa cells of the distal convoluted tubule, and juxtaglomerular cells of the afferent and efferent glomerular arterioles) in the mammalian kidney nephron; it controls glomerular blood flow by secreting renin.
- K strategist** Species that are long-term competitors; they are likely to encounter competition when population size reaches the carrying capacity ( $K$ ) of the environment.
- karyogamy** Nuclear fusion, for example in fungi.
- kelp** Giant marine brown alga, for example Australian bull kelp *Durvillea potatorum*.
- keratins** Fibrous proteins; long sequences with  $\alpha$ -helical secondary structure; in hair, feathers and skin.
- kidney** The excretory organ of vertebrates; the nephron is the functional excretory unit of the kidney.
- kin selection** Selection that takes into account relatives as well as direct descendants.
- kinesis** The movement of the bones of the jaw or skull that facilitates feeding.
- kinetic energy** Energy of movement, as in running water.
- kinetochore fibre** A microtubule fibre that is attached to the kinetochore.
- kinetochore** The two protein discs of a centromere, into which microtubules are inserted.
- kinetoplast** A large mass of DNA, composed of thousands of catenated DNA mini-circles (linked as in a chain) present in the mitochondrion of certain flagellate parasites (e.g. trypanosomes).
- kingdom** A higher level taxon (grouping) used in classification of organisms; above phyla.
- Krebs cycle** *See* citric acid cycle.
- kuru** A human disease caused by a prion; *see* prion.
- La Niña** An extreme weather event of wet conditions when there is major disruption of normal air and oceanic circulation in the Pacific region; it alternates with El Niño.
- labellum** A petal modified as the lip of an orchid flower.

- labium** An insect mouthpart derived from the fused pair of second maxillae.
- labrum** An anterior exoskeleton plate of an insect head that covers the mouth parts.
- lactose** A disaccharide found in milk of mammals; it is formed by the linking of the hydroxyl at carbon 1 of  $\beta$ -D-galactose to the hydroxyl at carbon 4 of D-glucose.
- lagging strand** A DNA strand that grows in an overall 3' to 5' direction but is synthesised discontinuously in short fragments (5' to 3') that are later joined by DNA ligase.
- lamellibranch** Bivalve mollusc, referring to the gills which are expanded as sheets or lamellae.
- laminarin** The storage product of brown algae; a  $\beta$ -(1 $\rightarrow$ 3)-glucan.
- laminin** An adhesive protein of the extracellular matrix, occurring in basement lamina.
- land degradation** The decline in the quality of the land due to soil acidification, erosion, salinity, etc.
- larva** The juvenile stage in the life cycle of many animals.
- laterite** A weathered land surface with ironstone gravel occurring at the surface or subsurface overlying a layer of bleached, white clay.
- Laurasia** The past supercontinent uniting all northern land masses.
- leading strand** A DNA strand that is synthesised continuously in a 5' to 3' direction.
- leaf** A lateral outgrowth from the stem; it is usually green and the main photosynthesis organ of a plant.
- leaf abscission** The dropping off of leaves normally following the formation of an abscission layer.
- learning** Any change in an individual's behaviour that is due to its experience.
- legume** A type of fruit; a pod that splits open on two sides, typical of peas and acacias.
- leishmania** A type of kinetoplast, a unicellular flagellate parasite that causes the disease Leishmaniasis, which is an infection of white blood cells; a disease transmitted by sand flies occurring in, for example, Africa and South America.
- Leishmaniasis** A disease transmitted by sand flies which causes an infection of white blood cells; *see* leishmania.
- lenticel** A special site for gas exchange in the periderm (outer layer of bark) of woody plants; the raised area of cells with extensive intercellular spaces.
- Lepidosauria** The evolutionary lineage of amniotes that includes the New Zealand Tuatara, snakes, lizards, skinks and geckos; with teeth fused to the edges of the jaws.
- leptin** A protein produced by adipocytes (white fat cells) by the Ob gene and which is involved in signalling the level of fat stores to the brain and other body organs.
- leucocyte** A class of nucleated white blood cells that protect the body against invasion and collect cellular debris.
- levans** A water-soluble fructose polymer; plant storage polysaccharide; it is in stems of grasses.
- lichen** The mutualistic relationship between a fungus and a green alga or cyanobacterium.
- life cycle** The sequence of stages in the growth and development of organisms from zygote to reproduction; in sexually reproducing organisms, these show an alternation between diploid and haploid stages.
- life table** A table consisting of probabilities of survival and expected number of offspring varying with age of individuals in a population.
- lift** The component of force acting at right angles to the direction of motion of a hydrofoil.
- ligand** A molecule or part of a molecule that binds selectively to one or more specific sites on a larger molecule; a signal molecule that is capable of interacting with a receptor.
- ligand-gated channel** A membrane ion channel that opens or closes in response to the binding of specific signalling molecules.
- ligase** An enzyme that joins (ligates) two molecules to form C–C, C–S, C–O or C–N bonds coupled with the hydrolysis of ATP or similar triphosphate.
- ligation** The covalent joining of DNA fragments by DNA ligase.
- lignin** The main component of secondary walls and wood of plants; composed of phenylpropanoid units, which provide a rigid matrix for cellulose fibres.
- lignotuber** Masses of dormant buds that form a swelling at the base of a stem, for example in eucalypts; the organ allows vegetative reproduction.
- ligulate floret** A type of flower (ray floret) on the outside of a daisy head that has elongated, fused petals strongly developed to one side.
- limiting resource** An environmental requirement of an organism that is in limited supply (e.g. food, nest site, etc.).
- linkage** The transmission of alleles of different genes located on the same chromosome at a frequency greater than that expected for independent assortment.
- lipid** A biological compound that functions in membranes, energy storage and transport, and insulation; it is insoluble in water as a result of the non-polar (hydrophobic) nature of their numerous C–H bonds; it is composed principally of carbon, hydrogen and oxygen together with phosphorus and nitrogen.
- lipid bilayer** A double layer of lipid molecules that forms the basic structure of cell membranes.
- Lissamphibia** Modern amphibians, for example salamanders, frogs, toads and caecilians.
- lithophyte** A plant that grows among rocks.
- liverwort** *See* Hepatophyta.
- local cycle** The cycling of material through ecosystems at a local scale; involving the soil (e.g. phosphorus).
- locus** The position of a gene on a chromosome; a locus may be occupied by any one of the alleles of a gene.
- long-day plant** A plant that must be exposed to light periods longer than some critical length for flowering to take place.
- loop of Henle** The part of the mammalian nephron (and some avian nephrons) that lies between the proximal and distal convoluted tubules; it enables the osmoconcentration of urine.
- lophophore** The feeding structure of ciliated tentacles containing extensions of the coelom in lophophorates.
- lorica** The external vase-shaped shell of some chrysophyte protists.
- lungfish** A fleshy-finned or lobe-finned fish, of the group named Sarcopterygii that includes land vertebrates, the tetrapods; the swim bladder functions as a lung; one species endemic to Australia (*Neoceratodus forsteri*).
- lungs** Invaginated gas-exchange surfaces connected to air outside the body via narrow airways; in mammals, the initial portion of the airway before it branches dichotomously into the bronchi leading to the lungs is known as the trachea.
- luteovirus** Viruses that cause various plant diseases, for example of cereals; transmitted by aphids.
- lyase** Enzymes that act on substrates with C–C, C–O and C–N bonds; for example their activities involve reactions that eliminate water.
- Lycophyta** A phylum of clubmosses and quillworts, non-seed vascular plants.
- lymph** A transparent fluid formed by filtration of liquid from capillaries into the interstitial space; it is collected by primary lymphatic vessels and returned to the blood; it contains white blood cells that attack invading organisms; it transports proteins and fats into the blood.
- lymph node** A nodule occurring at intervals along a lymphatic vessel where T cells and B cells encounter antigen to induce an immune response.
- lymphatic capillary** Fine vessels, originating in the tissues, that collect interstitial fluid and channel it to larger lymphatic vessels.
- lymphatic vessel** A vessel that drains the tissues of lymphocytes, ultimately leading them back into the blood.
- lymphocyte (lymphoid cell)** Small round cells that are the predominant cells in immune organs; it is responsible for the immune response; the two principal classes are T cells and B cells.
- lymphokine** Cytokines secreted by helper T cells that control the development and function of other T and B cells, as well as of accessory cells such as macrophages.
- lysis** The disintegration of a cell.

- lysosome** The membrane-bound component containing hydrolytic enzymes involved in the breakdown and recycling of many types of molecules.
- M phase** A phase of nuclear division (mitosis) in the cell cycle.
- macroevolution** The evolution at or above the species level.
- macronucleus** The larger of the two types of nuclei in ciliates; it develops from the micronucleus and contains multiple copies of genes on short pieces of DNA; it divides by simply pinching approximately in half.
- macronutrient** A nutrient element required by organisms in large amounts for healthy growth.
- macrophage** A large phagocytic white blood cell.
- madreporite** A porous disc; opening of the water vascular system of echinoderms.
- magnetic reversal** The reversal of the earth's magnetic field, from normal (present day) to reversed polarity (north becomes south and south becomes north).
- Magnoliophyta** A phylum of flowering plants (angiosperms).
- major histocompatibility complex (MHC) molecule** It presents (shows) antigen to T cells, without which T cells will not respond to antigen; it is fundamental to identification of 'self' and in graft rejection.
- malaria** A disease caused by the apicomplexan parasite, *Plasmodium* (k. Protista); it involves both a vertebrate host and a blood-sucking insect.
- male–male competition** A mechanism of sexual selection in which males compete over mating opportunities with females.
- Malpighian tubule** A blind-ended excretory tubule of arthropods; urine is formed by active  $K^+$  secretion into the tubule and passive solute and water influx; the urine is emptied into the hindgut.
- Mammalia** A class of vertebrates that is characterised by the presence of hair and suckling young.
- mandible** (pl. mandibles) The first pair of appendages in mandibulate arthropods used for feeding; for example in insects, modified for grinding and chewing (jaw-like) or piercing and sucking (stylets).
- Mandibulata** A major lineage of arthropods that includes myriapods, crustaceans and insects; *see* mandible.
- mantle (of molluscs)** The dorsal fold of the body wall with a cavity beneath it; it secretes the shell.
- mantle (of mycorrhiza)** The thick sheath of a mycorrhizal fungal mycelium surrounding a root, replacing epidermis and root hairs.
- mantle cavity** The space below the mantle of a mollusc that opens to the outside; it houses respiratory gills and receives the excretory, reproductive and alimentary openings.
- manubrium** The projection in a medusa (e.g. a jellyfish) on which the mouth is borne.
- mark-release-recapture method** A method used to estimate the abundance of a mobile animal population.
- marsupial** A metatherian mammal, for example a possum, koala and kangaroo; it characteristically has a marsupium (pouch) for carriage and concealment of developing young.
- marsupium** *See* marsupial.
- mass extinction** The extinction of many species at one time in the fossil record marking the end of a geological period, for example the Permian.
- mass-flow transport** The movement of a fluid (usually water) in bulk as a cohering mass (the movement is caused by a difference of hydrostatic pressure).
- mass number** The combined number of protons and neutrons in a nucleus.
- mass-specific food intake** The amount of food eaten by an animal divided by its mass.
- mass-specific metabolic rate** The metabolic rate of the animal divided by its mass.
- mast cell** The strongly staining basophilic cell in the tissues, associated with allergies but also important in guiding inflammation.
- mate-guarding behaviour** Male behaviour that ensures the female he mates with does not mate with another male.
- maternal-effect genes** Genes that are transcribed from the genome of the mother and whose products are deposited in the egg but act after formation of the zygote (i.e. after fertilisation).
- mating system** The number of partners each sex may have during its lifetime or during the mating season.
- maturation of behaviour** Behaviour that changes as a result of an individual's age, independent of the individual's experience.
- maturation effect** Those factors that influence the maturation of behaviour.
- maxilla** (pl. maxillae) A second pair of appendages; mouthparts in insects.
- maxillary gland** A blind excretory sac at the base of each of the second pair of maxillae in crustaceans.
- maximum sustainable yield (MSY)** The harvesting of a population at a rate that allows the population size to be maintained indefinitely.
- mechanically-gated channel** A membrane ion channel that opens or closes in response to physical disturbance, usually mediated by small changes in pressure across the membrane.
- mechanoreceptor** A type of receptor that detects stimuli such as mechanical pressure or stretch.
- median eminence** The part of the neurosecretory portion of the pituitary gland lying beneath the hypothalamus.
- medusa** The free-floating (pelagic), bell-shaped form of a cnidarian, with its mouth pointing downwards; jellyfish.
- megafauna** A variety of large animals that became extinct in Australia.
- megagametophyte** Haploid stage (gametophyte) that develops from the germination of a megaspore, the female spore, in the life cycle of some ferns, some clubmosses and all seed plants; in seed plants contained within an ovule.
- megakaryocyte** A large cell in the bone marrow that produces blood platelets.
- megaphyll** Large leaves, typical of ferns compared with earlier vascular plants such as lycophytes; *see* microphylls.
- megasporangium** The female sporangium of plants in which megaspores develop.
- megaspore** Haploid spore of some ferns, some clubmosses and seed plants that germinates into a female gametophyte, which bears archegonia with egg cells.
- megasporocyte** In a heterosporous plant, a diploid cell that undergoes meiosis to produce a megaspore; also known as megaspore mother cell.
- meiosis** Two specialised nuclear divisions (meiosis I and II) that result in a halving of the number of chromosomes of a diploid ( $2n$ ) germ cell to produce haploid ( $n$ ) daughter cells (gametes).
- melatonin** A hormone secreted by the pineal gland in the absence of light influencing diurnal and seasonal rhythms in a variety of vertebrates.
- membrane potential** The electrical voltage difference across a membrane.
- membrane transporter** A transmembrane protein that accelerates the movement of particular solute molecules across the membrane.
- memnospore** The sexual spore of a fungus; it allows survival during harsh conditions.
- memory cell** A long-lasting B or T cell formed after antigen stimulation; it is the basis of immunological memory.
- meroblastic cleavage** The cleavage of a fertilised egg that is not total; only part of the egg divides.
- merozoite** The stage in the life cycle of the malarial parasite, *Plasmodium*, that invades the red blood cells of the vertebrate.
- mesocarp** The middle layer of a fruit, for example the thick edible layer in peaches.
- mesoderm** One of the three germ layers, lying between the ectoderm and the endoderm; it gives rise to many of the internal organs, connective tissues and internal epithelia.
- mesoglea** The intermediate gelatinous layer, between the ectoderm and endoderm, in a cnidarian (e.g. a jellyfish).
- mesohyl** The middle layer of a sponge consisting of a gelatinous protein matrix containing amoeboid cells, collagen fibres and skeletal elements.
- mesophile** An organism that grows best between 10°C and 30°C.
- mesophyte** A plant that lives where water is in adequate supply; *compare* xerophyte.
- Mesozoic** The geologic era from 245 to 65 million years BP.

- metabolic depression** A reduction in metabolic rate; it may be regulated or unregulated.
- metabolic pathway** The chemical reactions in cells that occur in a step-by-step sequence.
- metabolism** All the chemical processes occurring within the cells of a living organism.
- metaboly** The sinuous gyration or crawling motion of euglenoids.
- metacercaria** The stage of parasitic flukes that encysts on vegetation; it is ingested by a vertebrate host.
- metameric segmentation** A body plan in animals in which there is linear repetition of functional units, which are added at the posterior end (e.g. in annelids).
- metamorphosis** the process where there is a marked change in body form during development; *see* incomplete and complete metamorphosis.
- metanephridium** (pl. metanephridia) The tubular excretory organ with a ciliated, funnel-like opening in the coelomic cavity that draws coelomic fluid into the tubule.
- metaphase** A phase of mitosis, in which chromosomes are arranged equatorially on the mitotic spindle.
- metaphase plate** The equatorial region of a metaphase cell in which the chromosomes are assembled.
- metarteriole** The smaller arterioles, surrounded by discontinuous muscle.
- Metatheria** Marsupials; one of the subclasses of mammals.
- metaxylem** Xylem tissue that forms outside the protoxylem in stems of plants; it has larger and thicker-walled cells than protoxylem, with reticulate secondary thickening.
- Metazoa** An alternative name for k; animalia (all multicellular).
- methanogen** A type of bacterium that uses hydrogen gas and carbon dioxide to generate energy and make sugars.
- MHC restriction** The phenomenon whereby T cells are restricted to recognising antigen presented by the MHC they have been programmed by in the thymus.
- micelle** A spherical structure formed when phospholipids are added to water; it forms because fatty acid tails of phospholipids are hydrophobic.
- microbial fermentation** A form of digestion in which symbiotic microorganisms in the gut produce enzymes that degrade foodstuffs into absorbable units.
- microbody** An organelle in eukaryotic cells involved in removal of compounds generated within a cell; it is spherical in shape and surrounded by a single membrane; it often contains crystalline inclusions.
- microcirculation** Circulation and exchange in arterioles, capillaries and venules.
- microevolution** A gradual change in gene pools, often over long evolutionary time periods.
- microfibrils** Regular aggregates of cellulose molecules associated through hydrogen bonds and van der Waals forces; embedded in a matrix containing polysaccharides, pectins and proteins in cell walls.
- microfilament** A fine fibre composed of filamentous chains of actin molecules; part of the cytoskeleton.
- microgametophyte** Haploid stage (gametophyte) that develops from the germination of a microspore, the male spore, in the life cycle of some ferns, some clubmosses and all seed plants; in seed plants, microgametophytes develop as pollen.
- micronucleus** The smaller of the two types of nuclei in ciliates; diploid with normal chromosomes and divides mitotically.
- micronutrient** A nutrient that is required in only small amounts.
- microphyll** A small simple leaf, typical of lycophytes.
- micropyle** The small opening in an ovule that allows the pollen tube to enter during fertilisation.
- microsatellite** A segment of DNA that consists of short repeated sequences; such segments are often polymorphic and can be used in DNA fingerprinting.
- microsporangium** The male sporangium of plants in which microspores develop.
- microspore** A haploid spore of some ferns, some clubmosses and seed plants that germinates into a male gametophyte, which produces sperm.
- microsporocyte** A diploid male spore-forming cell of plants that undergoes meiosis to form microspores and pollen grains.
- microtubule** A tubule 25 nm in diameter composed of tubulin dimers; it constitutes a major scaffolding component of the cytoskeleton in eukaryotic cells; it is associated with plasma membranes and forming spindle fibres during cell division.
- midbody** A dense body of actin, microtubules and other components that forms between daughter cells in the late stages of animal cytokinesis after contractile ring constriction.
- middle lamella** A thin layer between the primary wall of a plant cell; it is rich in pectins.
- mimicry** Where individuals of one species (mimics) have visual, behavioural, olfactory or other characters that resemble those of another species (models) and, as a consequence, individuals of another species classify them both as the same.
- Mimosaceae** The acacia (wattle) family.
- mineral element** An inorganic element required by organisms.
- mineralocorticoid** A steroid hormone secreted by the adrenal cortex; it is involved in Na<sup>+</sup> and K<sup>+</sup> balance.
- minimum viable population size (MVP)** The population size above which a species needs to be maintained to ensure its long-term survival.
- miracidium** The free-swimming ciliated stage of parasitic flukes.
- missense mutation** A mutation that changes the nucleotide sequence of a codon so that it encodes a different amino acid.
- mitochondrion** (pl. mitochondria) A DNA-containing organelle of eukaryotic cells; it is surrounded by a highly permeable double membrane; it contains circular DNA molecules, RNA and small ribosomes; the site of cellular respiration.
- mitogen** Stimulates mitosis of cells and thus has important functions in regulating growth and differentiation.
- mitosis** The process of a chromosome condensation, nuclear envelope breakdown, sister chromatid separation and formation of two daughter nuclei in eukaryotes.
- mitotic spindle** An elaborate cytoskeletal structure that causes chromosomes to move towards the equator at metaphase of mitosis, and the chromatids to separate and move towards the poles at anaphase.
- mitral valve** The valve between the left atrium and left ventricle of the mammalian heart.
- molality** Solute concentration of a solution, measured as the number of moles of a solute per kilogram of water.
- molarity** Solute concentration of a solution, measured as the number of moles of a solute per litre of solution.
- mole** The amount of a substance that contains the same number of atoms or molecules as there are in 12 grams of carbon-12 ( $6.022 \times 10^{23}$ , Avogadro's number).
- molecular clock** An estimate of evolutionary time based on the rate of change of DNA or protein sequences over time.
- molecular cloning** A commonly used technique for increasing the number of copies of a piece of DNA.
- molecule** The stable association of two or more atoms due to the sharing of electrons in their outer orbitals.
- Mollusca** A phylum of snails, octopuses and their relatives.
- Monera** A kingdom name often used for all prokaryotes (bacteria).
- monocarpic senescence** Plants that flower, fruit and die.
- monocistronic mRNAs** A transcription unit that contains a single open reading frame.
- Monocotyledon** One of the major types of flowering plant (class Liliopsida) that typically has one embryonic leaf in the seed; generally with flower parts in threes and parallel leaf veins.
- monocyte** The blood-borne precursor of the macrophage.
- monoecious** A type of animal in which both male and female reproductive organs occur within the same individual (also called hermaphrodite); a type of plant in which male and female organs are present in different flowers on the same plant.

- monogenean** A class of platyhelminths; ectoparasitic flukes.
- monohybrid cross** A cross involving organisms that are heterozygous at a single locus.
- monophyletic group** A group or taxon of organisms that includes all of the lineages descended from a common ancestor (i.e. an entire branch on a phylogenetic tree).
- monosaccharide** Sweet-tasting simple sugar that cannot be broken down into smaller sugar molecules; five-carbon pentoses and six-carbon hexoses are most common.
- monosynaptic reflex** A reflex movement that occurs when a sensory receptor excites a muscle across one synapse; only two cells and one synapse are involved so the response is very rapid.
- Monotremata** A group of egg-laying mammals; living examples are the echidna and platypus.
- morphogen** A molecule that induces pattern formation during development.
- morphogenesis** The generation of a new shape during development.
- mosaic development** Development in which the fate of blastomeres is predetermined and not influenced by interactions with surrounding cells.
- moss** See Bryophyta.
- motor neuron** A neuron that innervates a muscle and causes it to contract.
- motor unit** A neuroanatomical unit comprising a single motor neurone and the muscle fibres it acts upon; all the fibres act in unison, with an 'all or nothing response' when stimulated; smaller motor units permit finer control of force production and movement.
- M-phase-promoting factor** A specific cyclin and cyclin-dependent protein complex whose activity drives a cell from the G2 phase into the M phase.
- Murray Valley encephalitis** A disease caused by an arbovirus (arthropod-borne) related to yellow fever; it is found in the river systems and tropical north of Australia; it causes fever but sometimes death.
- mutagen** An environmental factor (e.g. radiation or chemicals) that induces mutations in DNA.
- mutation** A change in the nucleotide sequence of a DNA molecule resulting most commonly from errors in DNA synthesis or from chemical or radiation induced damage to DNA.
- mutualism** The symbiotic interaction between two species where both benefit from the association (e.g. lichen).
- mutualist** Living in partnership with another organism, where both organisms benefit from the relationship.
- Mycelia Sterilia** Fungi that produce no spores.
- mycelium** The body of a fungus, generally growing as filamentous hyphae.
- Mycophycota** A phylum of lichens.
- mycorrhiza** (pl. mycorrhizae) A mutualistic association between certain types of fungi and the roots of plants; it enhances nutrient uptake by the plant; it includes arbuscular, orchid, epacrid and ectomycorrhizae.
- mycorrhizal fungi** Fungi growing around or inside roots, where they receive organic nutrients from the plant and may improve the uptake of mineral nutrients by the plant.
- mycotoxin** A poison produced by a fungus.
- myelin (myelin sheath)** An insulation layer around some axons in vertebrates; it is formed by wrapping the axon in many layers of glial cell membrane.
- myobatrachids** A family of frogs found in Australia that has Gondwanan affinities.
- myocardium** The three-layered muscle composing the heart wall.
- myogenic** The initiation of the heart beat within cardiac muscle itself, for example, in vertebrate hearts.
- myoplasm** A yellow coloured cytoplasm in the sea squirt that segregates into particular cells of the blastula which, in turn, give rise to muscle.
- myosin** A protein that commonly interacts with actin filaments to generate cytoplasmic movements or changes in cell shape; it is organised into thick filaments in muscle cells.
- myotome** A block of muscle on each side of the body, as invertebrate chordates.
- myriapod** A millipede or centipede, subphylum Myriapoda, with many legs.
- myrmecotrophy** A mutualistic relationship where ants live within special chambers formed in certain plants.
- Myrtaceae** A southern hemisphere plant family that includes eucalypts, bottlebrushes, lily pilli and paperbarks.
- myxamoeba** The amoeba of slime moulds.
- myxoedema** A condition associated with the accumulation of water as a result of lack of thyroid hormones in adult humans.
- myxomatosis** A disease of European rabbits that is caused by myxoma poxvirus; the virus was used in the past as a biological control of rabbits in Australia.
- natural killer (NK) cell** A lymphocyte lacking the antigen receptors of T and B cells but having a major role in defence against viruses by lysis of infected cells and production of interferon.
- natural selection** The process of differential rates of reproduction and survival of offspring, proposed by Darwin as a basis for evolution; members of a population that possess particular heritable characteristics will survive and leave more offspring than members with less favourable characteristics.
- nauplius** (pl. metanephridia) The tubular excretory organ with a ciliated, funnel-like opening in the coelomic cavity that draws coelomic fluid into the tubule.
- nautiloid** An early type of extinct mollusc (cephalopod) related to the living *Nautilus*.
- Neanderthal** Fossils of the genus *Homo*, dating from 130,000 years ago, originally found in the Neander Valley of Germany; with a brain as large as modern humans, and tool-makers.
- negative feedback control** A control system where the response produced to a particular stimulus reduces the size of the original disturbance; it leads to homeostasis.
- negative regulation** The regulation of a gene such that expression of the gene is repressed by the presence of a particular molecule.
- nematocyst** The stinging organelle of cnidarians (e.g. jellyfish), which functions in defence and capture of prey; nematocysts are also called cnidae.
- Nematoda** A phylum of roundworms.
- Nemertea** A phylum of proboscis worms (nemerteans).
- neo-Darwinian theory of evolution** A fusion of Darwin's theory of evolution by natural selection with Mendel's laws of heredity and the mathematical principles of population genetics.
- Neotropical region** A biogeographical region of the world including South America and lower Central America.
- nephridium** (pl. nephridia) The tubular excretory organ of invertebrates that develops from the body surface into the coelomic cavity; it is either a protonephridium or a metanephridium, depending on the structure of the coelomic end.
- nephron** The tubular excretory unit of the vertebrate kidney; it is derived from a coelomoduct but lacks a ciliated, funnel-like opening.
- net primary productivity** The portion of total (gross) primary productivity that remains after the respiratory losses of primary producers are accounted for.
- neural crest cells** In vertebrates, a group of cells formed as the neural tube detaches from the overlying ectoderm; they migrate individually throughout the embryo and ultimately differentiate into many different cell types, such as peripheral nerves and much of the face.
- neural fold** Folds of tissue that rise upwards either side of the neural groove.
- neural groove** A groove in the ectoderm that is the first step in formation of the neural tube.
- neural plate** The region of dorsal ectoderm in vertebrate embryos that forms the neural tube.
- neural stem cell** A stem cell that can proliferate and differentiate to give rise to all neural tissue types.
- neural tube** The structure in vertebrate embryos from which the spinal cord and brain form.
- neuraminidase** A type of protein; for example a surface protein in the lipid outer membrane of the 'flu' virus.
- neurogenic** Initiation of the heart beat by nerves leading to the heart muscle, for example, in many invertebrate hearts.

- neurohaemal organ** An organ in which axons release their neurosecretions into the blood.
- neuron** A cell specialised for receiving, conducting and transmitting information to other cells; the basic unit of the nervous system.
- neurosecretion** Secretion of hormones by nerve cells.
- neurotransmitter** A water-soluble signal molecule released from nerve endings at a synapse with an effector cell; it acts on receptors located on other nerve cells, muscle cells or glands.
- neurula** An embryonic stage in vertebrates during which the neural tube forms.
- neurulation** The process of neural tube formation.
- neutral mutation** A mutation that has no effect on Darwinian fitness.
- neutron** A subatomic particle that is uncharged; part of the nucleus of an atom.
- neutrophil** A small phagocytic cell in blood and sites of inflammation, has an irregular nucleus and neutral staining granules full of digestive enzymes in the cytoplasm; it is also referred to as a polymorph or granulocyte.
- nitrifying bacteria** Chemoautotrophic bacteria that use ammonium ions as an energy substrate and reductant; produce nitrite and nitrate; for example *Nitrobacter*; important in the nitrogen cycle.
- nitrogen cycle** The movement of nitrogen through ecosystems; involving soil microorganisms that fix or release nitrogen.
- nitrogen fixation** The conversion of gaseous, atmospheric nitrogen by certain bacteria to ammonia, nitrites and nitrates.
- nitrogen mineralisation** The conversion by microorganisms of organic nitrogen compounds in soil to simple ions in solution.
- nitrogenase** An enzyme that catalyses the reduction of molecular nitrogen ( $N_2$ ) to ammonium ions; *see* nitrogen-fixing bacteria.
- nitrogen-fixing bacteria** Bacteria able to reduce (fix) molecular nitrogen ( $N_2$ ) to ammonium ions; for example *Rhizobium* associated with plant roots; the important first stage of the nitrogen cycle.
- nitrogenous base** One of the parts of a nucleotide in DNA and RNA; pyrimidines with a single ring of carbon and nitrogen atoms (uracil, cytosine and thymine) and purines with a double ring (adenine and guanine).
- node** The site on the stem at which leaves are attached.
- node of Ranvier** A small bare region of axon between Schwann cells that form myelin sheaths; it allows saltatory conduction of action potentials from node to node.
- non-cellulosic polysaccharides** A porous, hydrated, gel-like matrix of polysaccharides other than cellulose, within which cellulose microfibrils lie in a plant cell wall.
- non-coding DNA** DNA sequences that do not encode amino acids incorporated into polypeptides during protein synthesis.
- non-covalent bond** A diverse group of forces that involve electrical charge interactions between atoms or molecules; it is weaker than covalent bonds; it includes hydrogen bonds, ionic bonds and van der Waals forces.
- non-cyclic photophosphorylation** The process of production of ATP in plant photosynthesis in which electrons flow one way from water through photosystems II and I and are not recycled back to them but end up in NADPH.
- non-insulin-dependent diabetes mellitus (Type II or maturity onset diabetes)** A disease caused by a relative lack of insulin and usually not identified until middle-age; it is often associated with obesity and can be controlled by diet.
- nonsense mutation** A mutation that changes the nucleotide sequence of a codon so that it becomes a stop codon and causes premature termination of translation.
- Nothofagus** Southern beech trees.
- notochord** A cylindrical rod situated below the nerve cord and above the gut in all chordates; it provides support and lateral flexibility to the body.
- nuclear division (mitosis)** The process of a chromosome condensation, nuclear envelope breakdown, sister chromatid separation and formation of two daughter nuclei in eukaryotes.
- nuclear envelope** A double membrane surrounding the nucleus in eukaryotic cells.
- nuclear pore** A channel in the nuclear envelope that allows movement of certain molecules between the nucleus and cytoplasm.
- nucleic acid** A molecule consisting of long chains of nucleotides joined through phosphodiester bonds; the DNA and RNA of living organisms.
- nucleoid** The circular DNA molecule of prokaryotes compressed with the aid of folding proteins and RNA; it is located in the cytosol.
- nucleolus** A spherical fibrillar and granular structure within the nucleus of eukaryotic cells; it is composed chiefly of rRNA in the process of being transcribed from multiple copies of rRNA genes.
- nucleomorph** A remnant of an endosymbiont's nucleus found in the cells of a number of protistan groups; it is evidence of their plastids being acquired by secondary endosymbiosis.
- nucleosome core particle** A complex of eight histone proteins that form a core around which the double helix of DNA is coiled to form a nucleosome.
- nucleosome** A particle about 10 nm in diameter comprising nucleosome core particle (histone proteins) and associated wrapped DNA; chromatin consists of DNA wrapped to form long strings of nucleosomes.
- nucleotide** Five-carbon sugar, a phosphate group and a nitrogenous base; nucleotides are linked together by phosphodiester bonds between the sugar and phosphate groups to form nucleic acids.
- nucleus** The principal membrane-bound compartment of the eukaryotic cell; control centre of the cell; it contains chromosomal DNA.
- nymph** A juvenile stage of development in insects that is similar to the adult but lacks wings and is not sexually mature.
- obesity** An excess of adipose (fat) tissue in relation to gender, age and height.
- oceanic ridge** The site where lava upwells from part of the earth's mantle.
- ocellus** (pl. ocelli) The simple eye of adult arthropods.
- oedema** The build-up of fluid in tissues when filtration exceeds reabsorption and lymph flow; it is usually associated with vascular disease.
- oestrogen** A steroid hormone including oestradiol, oestrone and oestriol; it is produced by ovarian follicles.
- Okazaki fragment** A short segment of DNA synthesised from an RNA primer on the lagging strand; the Okazaki fragment is synthesised until the previous primer-Okazaki fragment is encountered.
- oligochaete** Annelids of the subclass Oligochaeta; for example earthworms.
- omnivore** An animal that feeds on a variety of organisms, for example, plants and animals.
- onchosphere** The six-hooked larva that hatches from the egg of a tapeworm.
- oncogene** A tumour-causing form of a gene.
- one-way digestive tract** A digestive system in which food enters via a mouth and exits via an anus; contrast with simple digestive cavities in which food enters and leaves via the same opening.
- ontogeny** The development of an organism.
- oocyte** A female germ cell undergoing meiosis within the ovary.
- oogenesis** The process by which eggs form from primordial germ cells.
- oogonia** Diploid female germ cells undergoing mitosis; in animals, within the ovary; in protists, within oogonia (female reproductive structure).
- oogonium** The female reproductive organ (e.g. in a brown alga) that produces eggs (ova).
- oomycete** Water mould or downy mildew classified in the k. Protista; for example *Phytophthora cinnamomi* that causes jarrah die-back; the cell walls of cellulose and form coenocytic hyphae.
- open reading frame** A nucleotide sequence that can encode a polypeptide (i.e. that has a string of codons in frame that encodes amino acids).
- operculum** A cap-shaped covering, for example, apical portion of a moss spore capsule or covering formed from fused sepals or petals of a eucalypt flower bud.
- operon** In bacteria, a region of the chromosome that contains a transcription unit and the associated regulatory genes and sequences required for regulated transcription of the unit.
- Ophiuroidea** A class of echinoderms; brittle stars.
- opisthosoma** In arthropods, the abdomen, posterior region of the body behind the prosoma.

- oral arm** The arm-like extension of the manubrium of many medusae (jellyfish).
- oral disc** The top end of an anthozoan (anemone or coral) polyp that is ringed with tentacles.
- orbital** The zones of space in which electrons exist at any one moment around the nucleus of an atom.
- Orchidaceae** The orchid family.
- order** A higher level taxon (grouping) used in classification of organisms; between class and family.
- organelle** A specialised part of a cell, such as a nucleus or ribosome.
- organic molecule** A molecule composed principally of six elements—hydrogen, carbon, oxygen together with nitrogen, phosphorus and sulfur.
- organiser** A group of cells that secrete a morphogen.
- organogenesis** The process of organ formation.
- origin** The start sequence of DNA replication; there is a single origin in the circular DNA molecules of prokaryotes, but multiple origins in eukaryote chromosomes.
- orthologous genes** Two genes in different species that are derived from the same gene in a common ancestor.
- osculum** (pl. oscula) The opening in the wall of a sponge through which water leaves.
- osmoconcentration** The physiological process whereby water is resorbed from the urine by excretory tubules, making the urine more osmotically concentrated than body fluids.
- osmoconform** To have the same osmotic concentration of body fluids and the external medium.
- osmolality** Solute concentration of a solution, measured as the number of moles of all dissolved solutes per kilogram of water.
- osmolarity** Solute concentration of a solution, measured as the number of moles of all dissolved solutes per litre of solution.
- osmolyte** Any solute molecule that is dissolved in solution and contributes to its total concentration of osmotically-active particles.
- osmoregulate** To maintain an osmotic concentration of the body fluids different from that of the external medium.
- osmosis** The movement of water from a region of low osmotic concentration (high water concentration, high water potential) to one of high osmotic concentration (low water concentration, low water potential), as a result of the random thermal motion of water molecules through a selectively permeable membrane.
- osmotic potential** A measure of the reduction in the free energy of water due to the presence of dissolved solutes (e.g. salt or sugar).
- ossicle** A crystal of calcium carbonate; it is first formed within a cell and enlarging to a plate beneath the skin; forming the skeleton of echinoderms.
- osteoporosis** The depletion of bone calcium in women as a result of decreasing oestrogen levels after menopause.
- ostium** (pl. ostia) The pore in the wall of a sponge through which water enters during filter-feeding.
- ostracoderm** An extinct jawless fish from the Ordovician and Devonian periods, which was the first vertebrate.
- ovary** (pl. ovaries) The female reproductive organ, in which germ cells undergo differentiation into eggs and hormones are produced to regulate reproductive function; in flowering plants, the basal part of the carpel that contains ovules and which develops into the fruit after fertilisation.
- oviparity** The release of eggs that are fertilised externally.
- ovoviviparity** The development of fertilised eggs within the female parent.
- ovulation** The release of a mature egg cell from the ovary.
- ovule** Megagametophyte is retained within the megasporangium, which is further surrounded and protected by one or more layers of cells, the integuments; following fertilisation, the whole structure (the ovule) develops into a seed.
- ovuliferous scale** A leaf-like structure (thought to be a reduced shoot) that bears ovules; it is aggregated into female cones.
- ovum** (pl. ova) Female gamete; egg cell.
- $\beta$ -oxidation** The pathway in which lipids are processed for the release of energy in cells.
- oxidation–reduction (redox) potential** The measure of the tendency to donate or accept electrons, expressed in volts or millivolts (symbol  $E_0'$ ).
- oxidation–reduction reaction** A chemical reaction involving the transfer of electrons; losing an electron is oxidation and gaining an electron is reduction.
- oxidative respiration** A cellular respiration pathway that uses oxygen, allowing extraction of more ATP from the breakdown of glucose than anaerobic respiration.
- oxidised** When an atom or molecule gains an electron.
- oxidoreductase** An enzyme that catalyses reactions that transfer electrons, usually in the form of hydrogen ions or hydrogen atoms.
- oxygen-carrying capacity** The maximum amount of oxygen that can be carried by a fluid; in many animals the oxygen carrying capacity of body fluids is improved by the addition of respiratory pigments.
- oxygenic photosynthesis** The type of photosynthesis in algae and land plants in which oxygen is the product of the overall reaction to fix carbon dioxide as sugars.
- oxytocin** A posterior pituitary hormone that influences reproductive functions.
- ozone 'hole'** The thinning of the ozone layer due to depletion of ozone; for example, over Antarctica.
- pacemaker** See sinoatrial node.
- paired mouthparts** Modifications of the mouth that allow two parts to work against each other to enhance the ability to grip or crush or pierce food.
- pair-rule genes** Genes expressed in a two-segment periodicity and required for formation of segments.
- Palaeotropical region** The biogeographical region of the world including Africa (Ethiopian region) and India and South-East Asia (Oriental region).
- Palaeozoic** 'Ancient life'; the geologic era 570 to 245 million years BP.
- palisade mesophyll** The elongated cells of the leaf mesophyll arranged perpendicularly to the leaf surface.
- pancreas** An organ with exocrine (releasing digestive juices into the duodenum) and endocrine (releasing insulin from islet cells) functions.
- pancreozymin/cholecystokinin** A hormone released from gastrointestinal mucosa into local blood vessels; it optimises the composition of digestive juices released by the pancreas and gall bladder.
- Pangaea** The supercontinent uniting all northern (Laurasia) and southern (Gondwana) landmasses that formed, and then fragmented, during the Mesozoic.
- parabasalid** Flagellates (k. Protista) with a single nucleus and involved in commensal or parasitic relationships with animals; it typically has a parabasalid body, a large Golgi-type membrane complex near the basal body.
- paracrine hormones** Animal hormones that usually act over very short distances, travelling by diffusion through extracellular fluid.
- parallel evolution** The independent gaining (in evolution) of similar features in related organisms.
- paralogous genes** Two genes within one genome that are derived by duplication from the same gene.
- paralytic shellfish poisoning (PSP)** An illness caused by toxins, from certain dinoflagellates, which move through marine food chains; it affects the nervous system of humans.
- paramylon** A  $\beta$ -(1 $\rightarrow$ 3)-glucan storage product in euglenoids that forms solid granules in the cytoplasm.
- parapatric speciation** Divergence in populations, initially in geographic isolation and subsequently when the populations again come in contact, leading to formation of new species.
- paraphyletic group** A group or taxon of organisms that excludes some of the descendants of a common ancestor; non-monophyletic.
- paraphysis** (pl. paraphyses) Sterile hair (e.g. associated with reproductive structures in mosses).
- parapodium** (pl. parapodia) A lateral, paired appendage on the body segments of polychaetes; it functions in gas exchange and locomotion.

- parasite** An organism that lives and feeds on or in another organism, the host, which is usually larger than the parasite.
- parasitism** The symbiotic interaction between two species where one benefits and the other is harmed.
- parasitoid** An insect that is free-living as an adult but parasitic as a larva.
- parasympathetic nervous system** That part of the autonomic nervous system arising in the brain stem and sacral spinal cord.
- parathyroid hormone** A peptide hormone released by the parathyroid gland; it increases  $\text{Ca}^{++}$  concentration in the plasma by a variety of means.
- Parazoa** A subkingdom of animals that includes sponges; *compare* Eumetazoa.
- parenchyma** Large living cells that form the ground tissue of plants, comprising large, thin-walled cells, large central vacuole and a peripheral nucleus and cytoplasm.
- parental care** Any kind of parental behaviour, including preparation of nests, care of eggs inside the body or provisioning of young after birth.
- parthenogenesis** A mode of reproduction, found in some sexually reproducing organisms, in which the male plays no role.
- partial pressure** The partial pressure of a gas in a mixture of gases occupying a fixed volume is the pressure exerted by the gas if it alone occupied the volume; that is, the total pressure of a mixture of gases is the sum of the partial pressures of each gas.
- pathogen** An organism capable of causing disease.
- pathogen-associated molecular pattern** The molecules on the surface of pathogens which trigger the innate immune system.
- pattern formation** The process of generating the pattern of different tissues in the developing embryo.
- pectin** A type of polysaccharide found in plant cell walls; the backbone of the molecule formed from galacturonic acid (an acidic monosaccharide); good gel-forming molecules.
- pedipalp** (pl. pedipalps) A second pair of appendages of the cephalothorax in arachnids; it is modified for various functions; it corresponds to insect mandibles.
- pelagic realm** The marine biogeographic region including the surface water of open oceans and planktonic organisms.
- pellicle** Proteinaceous strips arranged in a spiral providing support, and giving shape, to euglenoid cells.
- penetrance** The proportion of individuals of a particular genotype that show a phenotypic effect.
- penis** The intromittent organ of males used for transferring sperm during internal fertilisation in many animals.
- pennate, of diatom** A bilaterally symmetrical type of diatom.
- peptide bond** A bond formed when the acidic carboxyl group ( $-\text{COOH}$ ) of an amino acid attaches to the amino group ( $-\text{NH}_2$ ) of another, with the release of a molecule of water.
- peptidoglycan** A type of molecule found in the cell walls of bacteria and the plastids (cyanelles) of glaucophytes, a group of protists.
- pericarp** A fruit wall, comprised of exocarp, mesocarp and endocarp.
- pericycle** The layer of cells in a root that surrounds the vascular cylinder; the site of initiation of lateral roots.
- periderm** A protective outer tissue that replaces the epidermis in secondary stems and roots of woody plants; corky tissue.
- peridinin** A xanthophyll; an accessory photosynthetic pigment found in dinoflagellates.
- peripheral nervous system** A peripheral part of the autonomic nervous system in vertebrates, which comprises ganglia and connecting nerves, and is classified into three subsystems—sympathetic, parasympathetic and enteric divisions.
- peristalsis** An involuntary wave of contraction of the circular muscles (and their subsequent relaxation) that propels material along a tubular organ (e.g. the oesophagus).
- peristaltic locomotion** The movement of an animal by alternate constriction and widening of the body; it depends on a fluid-filled body cavity, as in annelids.
- peristome** Specialised rows of teeth-like structures around the top of a moss sporangium; it shelters spores.
- peristomium** The first segment of an annelid.
- peroxisome** A type of microbody in eukaryotic cells that contains numerous enzymes; it is involved in the production and degradation of peroxides and oxidation of amino acids and uric acid.
- pest** An animal, often an introduced species, that is troublesome in ecosystems.
- petal** In a flower, one of the inner floral leaves; often brightly coloured to attract pollinators.
- pH** The concentration of hydrogen ions ( $\text{H}^+$ ) in solution; it is measured on a logarithmic scale ranging from 0 to 14.
- phaetophyte** *See* brown alga.
- phagocytic cell (phagocyte)** A cell capable of engulfing particles, for example bacteria.
- phagocytosis** A method of ingestion of food by endocytosis utilised by unicellular organisms, such as sponges, whereby a food particle is engulfed in a membrane-bound food vacuole.
- pharyngeal slit** (pl. pharyngeal slits) Paired openings appearing in the pharynx of chordates at some stage of development.
- phellogen** *See* cork cambium.
- phenotype** The set of detectable properties or traits of an organism.
- phenotypic frequency** The frequency of particular phenotypes (e.g. height, weight and colour) in populations.
- pheromone** A hormone released into the external environment for chemical communication between individuals.
- phloem** The transport tissue of vascular plants comprising several cell types, including sucrose-transporting sieve cells, companion cells and sclerenchyma fibres.
- phospholipid** A molecule consisting of long-chain fatty acids and phosphate; it is found in biomembranes; it has a hydrophobic and hydrophilic region.
- phosphorus cycle** The movement of phosphorus through ecosystems; a local cycle primarily involving the soil.
- phosphorylation** The addition of a phosphate group to a compound; it often results in the formation of a high energy bond (e.g. ATP from ADP).
- photoautotroph** An organism that gets its energy from sunlight and uses carbon dioxide as a carbon source (e.g. photosynthetic plants, algae and cyanobacteria).
- photodormant** Seed dormancy that can be broken by light.
- photoheterotroph** An organism that uses sunlight for energy but organic compounds (rather than carbon dioxide as in plants) as ready-made building blocks for growth and development (e.g. purple and green bacteria).
- photon** The elementary particle of electromagnetic radiation (light).
- photoperiodism** A plant response (e.g. flowering) to the length of light and dark periods in a 24-hour cycle.
- photoreceptor** A type of receptor that detects light by absorbing it at a particular wavelength.
- photorespiration** A light-activated type of respiration found in the chloroplasts of plants in which Rubisco uses  $\text{O}_2$  as a substrate to oxygenate RuBP and produce  $\text{CO}_2$  as a product of oxygenation.
- photosynthesis** The process by which solar energy is harvested and used to convert  $\text{CO}_2$  and water into carbohydrates; it involves absorption of energy from sunlight by means of pigments, reactivation of pigments and carbon fixation to produce sucrose in 'dark reactions'.
- photosystems I and II** Two light-harvesting systems consisting of protein molecules associated with pigments, embedded in the thylakoid membranes of chloroplasts.
- phototroph** An organism that uses radiant energy (light).
- phototropism** A tropism in which light is the stimulus; for example the bending or turning of a stem towards a light source.
- phragmoplast** Structure containing the remnants of spindle fibres orientated at right angles to the new cross-wall forming during cell division in all plant cells and some related green algae (charophytes).
- phycobilin** A type of water-soluble pigment characteristic of cyanobacteria giving them a bluish colour; also called 'blue-green algae'.

- phycocyanin** A photosynthetic pigment; *see* red alga.
- phycoerythrin** A photosynthetic pigment; *see* red alga.
- phycoplast** A system of microtubules orientated in the plane of cell division following the collapse of the spindle during cytokinesis; a feature of many green algae.
- phyllode** Laterally compressed petiole and rachis; foliage that replaces true leaves in most Australian acacias.
- phyllotaxy** The geometric pattern of leaf arrangement on a stem of plants (e.g. spiral).
- phylogenetic tree** *See* cladogram.
- phylogeny** Evolutionary relationships of organisms, usually depicted as a branching tree diagram (phylogenetic tree).
- phylum** A higher level taxon (grouping) used in classification of organisms, below the level of kingdom.
- phytochrome** A plant pigment that absorbs light; it exists in two interconvertible forms, P<sub>r</sub> (inactive form) and P<sub>fr</sub> (active form); it is involved in the timing of flowering, dormancy and seed germination.
- pilus** The structure (sex pilus) in some bacteria that enables transfer of DNA from one cell ('male') to another ('female') during conjugation.
- pinacocyte** *See* pinacoderm.
- pinacoderm** The outer surface of a sponge, consisting of a layer of flattened cells (pinacocytes).
- pineal gland** In vertebrates, an outgrowth in the midline of the roof of the third ventricle, which is used to measure photoperiod; in fishes, amphibians and some reptiles, it may contain photoreceptor cells (the 'third eye'); in mammals and birds, it is a neurosecretory organ releasing melatonin at night.
- pinealocyte** Modified photosensory cells with a secretory function only; it is located in the pineal gland of mammals, birds and snakes; a major hormone released is melatonin.
- pinna** (pl. pinnae) A leaflet of a compound leaf.
- pinocytosis** The mode of capillary exchange whereby large particles and lipid-insoluble materials are exchanged slowly via numerous tiny vesicles.
- pit connection** The connection between adjacent cells in the thallus of red algae.
- pith** Parenchyma cells that lie centrally within the vascular tissue of stems and some roots.
- pituitary gland (hypophysis)** The gland at the base of, and largely controlled by, the hypothalamus; it is composed of the median eminence, the anterior pituitary gland (adenohypophysis—an endocrine gland) and the posterior pituitary gland (neurohypophysis—a neurosecretory gland).
- placenta** An organ that enables exchange between an embryo and the maternal circulation; it is present in marsupial and placental mammals.
- placoderm** The extinct, large armoured, jawed fish of the late Silurian and Devonian periods.
- plant hormone** An organic substance produced in one part of a plant and transported to another part where it has its effect.
- Plantae** A kingdom that includes all green, land plants.
- planula** A ciliated type of animal larva.
- plaque** A small circular clearing in a lawn of bacteria caused by bacteriophage-induced lysis of the bacteria; under normal plating conditions, each plaque arises from a single bacteriophage, which infects a cell and initiates rounds of replication, cell lysis and further infection of adjacent bacteria.
- plasma** The transparent, slightly yellowish fluid component of blood without the cellular components; it is obtained by centrifugation.
- plasma cell** A non-dividing, antibody-secreting B cell formed after binding of antigen to the specific receptor of a B cell in the presence of helper T cells.
- plasma membrane** The boundary of living cells separating a cell from its environment; it is formed from a phospholipid bilayer.
- plasmid** A small circular extrachromosomal DNA molecule in bacterial cells, often carrying genes conferring antibiotic resistance.
- plasmodesma** (pl. plasmodesmata) The special channel connecting plasma membranes and cytosols of adjacent plant cells through primary cell walls.
- plasmodium** A large multinucleate cell resembling a slimy scum, often bright yellow; a stage in the life cycle of acellular slime moulds (myxomycetes).
- plasmogamy** Cytoplasmic fusion between eukaryote cells.
- plasmolysis** The shrinkage of cytoplasm due to loss of water by osmosis, drawing the plasma membrane away from the wall.
- plastid** The organelle of plant and algal cells that is surrounded by a double membrane; it is generally larger in size than mitochondria and contains circular DNA molecules, RNA and small ribosomes; it functions in processes such as photosynthesis, starch storage and geotrophism.
- plastron** In turtles and tortoises; a ventral, protective shield covered by horny plates.
- platelet** Anucleate disc-shaped cell fragments derived from megakaryocytes in bone marrow; it is involved in several aspects of blood clotting.
- plate tectonics** A modern geological theory that recognises that the earth's crust and part of the upper mantle (together the lithosphere) are divided into a number of plates that move relative to one another.
- Platyhelminthes** A phylum of flatworms.
- platyrrhine** A New World monkey (South America); flat-nosed; nostrils far apart and nose-lip area haired; many have a prehensile tail.
- pleiotropy** The effect of one gene on multiple traits.
- plesiomorphic** A primitive character considered to be ancestral in a group of organisms.
- pluripotent** The ability of cells to produce a range of cell types, for example, blood-forming stem cells.
- pneumatophore** Upright aerial root of mangroves; it is exposed at low tide and functions in gas exchange.
- point mutation** A mutation that affects one or a small number of nucleotides.
- polar nuclei** The two nuclei present in the central cell of the embryo sac of flowering plants.
- polar transport** The directed movement within plants of compounds (usually hormones) predominantly in one direction.
- pole cell** The cell that forms at the posterior end of the *Drosophila* embryo and gives rise to germ line cells.
- pollen** A collective term for pollen grains; the microgametophytes of seed plants, which develop sperm and can be transported by wind or animals.
- pollen grain** The products of microsporogenesis in a seed plant.
- pollen tube** A tube produced by the pollen grain after pollination that carries the sperm cells to the ovule.
- pollination** The process in which pollen of flowering plants is transferred by animals, air or water currents to the stigma for fertilisation.
- polyadenylation** The process in which a series of A residues are added to the 3' end of an RNA transcript.
- polyarch xylem** A pattern of xylem development in roots of monocotyledons among flowering plants, in which the xylem does not fill the centre, but is divided into many ridge-like projections (archs).
- polycistronic mRNA** A transcript that contains more than one reading frame which is translated to produce more than one protein.
- polygenic** A phenotype influenced by multiple genes.
- polyisoprenoid lipid** A diverse group of lipids formed by polymerisation of isoprenoid building blocks; it plays a role in membranes and cell-cell signalling.
- polymorph** The shortened term for 'polymorphonuclear neutrophil'; a phagocytic white blood cell characterised by an irregular nucleus and neutral staining granules in the cytoplasm containing digestive enzymes.
- polymorphic locus** A locus in which two or more alternative allelic genes occur in a population, where at least two of the alleles occur frequently.
- polymorphism** The occurrence in a population of two or more alternative and distinct phenotypes under the control of allelic genes, where at least two of the phenotypes occur frequently.
- polyp** An attached tubular form of a cnidarian with its mouth upwards.

- polypeptide chain** A molecule of many amino acids joined together by peptide bonds; a protein is a large polypeptide chain.
- polyphyletic group** A group or taxon of organisms that are unrelated to one another and based on superficial resemblance due to convergent evolution.
- polyploidy** The existence of more than two sets of homologous chromosomes in a genome.
- polyprotein** A large molecule consisting of a number of protein parts; for example some viral proteins.
- polyprotodont** A marsupial with more than one pair of incisor teeth in the lower jaw.
- polysaccharide** A carbohydrate composed of many monosaccharides joined in long linear or branched chains (polymers).
- polysome** A number of ribosomes attached to the same mRNA strand, each at different stages of protein synthesis; it may be free in the cytosol or attached to endoplasmic reticulum.
- pome** A fleshy fruit from an ovary of an epigynous flower.
- Pongidae** A family of great apes that includes the orang-utan, gorilla and two species of chimpanzee; it is traditionally separate from the family Homindae, which includes humans, although Pongidae is a paraphyletic taxon.
- population** A group of organisms of the same species living in a defined geographic area.
- Porifera** A phylum of sponges.
- porphyrin ring** In a chlorophyll molecule, a central metal atom (magnesium) surrounded by a ring of alternating single and double bonds.
- positive regulation** The regulation of a gene such that expression of the gene is induced by the presence of a particular molecule.
- posterior pituitary gland (neurohypophysis)** In most vertebrates; it is a neurohaemal organ containing axons whose cell bodies are located in the walls of the third ventricle; it secretes peptides that affect water balance and reproduction.
- potential distribution** Of a species; the range over which individuals could theoretically survive and reproduce.
- potential energy** Stored energy, such as chemical energy stored in the bonds of atoms and molecules.
- potyvirus** The most common type of plant virus; named after the potato virus Y; causes the diseases of crops but also attractive colour changes in flowers.
- power** In mechanical terminology, it is the rate at which work is done and is measured in joules per second (equals watts).
- Precambrian** The oldest era in the geologic time scale; before 570 million years ago.
- precapillary sphincter** The band of smooth muscle at the entrance of a true capillary; it opens or closes the vessel in response to local influences.
- predator** An organism that catches and kills another organism for food.
- predator-prey cycle** Oscillations in population size where predator numbers follow those of the prey.
- preferential channel** The main capillary route for blood flow through a tissue when metabolic demands are minimal.
- preprophase band** A band of microtubules that forms prior to mitosis at the site of the future cell division plane.
- pressure potential** The energy level of water as a result of hydrostatic pressure or suction.
- primary cell wall** The first wall of a plant cell, composed of cellulose, pectins and non-cellulosic polysaccharides.
- primary lymphoid organ** The site of differentiation of lymphocytes, for example thymus and bone marrow.
- primary pit-field** An area of the primary cell wall where plasmodesmata are concentrated and the site where a pit will occur following development of a secondary cell wall.
- primary response** The initial immune response to an antigen, usually resulting in immunological memory, which causes a later immune response to the same antigen to be larger and more rapid.
- primary structure** Of a protein; determined by the sequence of amino acids.
- primary transcript** The RNA molecule produced by transcription prior to processing.
- primase** The RNA polymerase that synthesises short RNA strands (primers) that are used by DNA polymerase to initiate DNA synthesis.
- Primates** An order of mammals including lemurs, tarsiers, monkeys and great apes.
- primer** A short sequence of bases that pairs with a complementary sequence in a strand of DNA and provides a free hydroxyl end for DNA polymerase to commence synthesis of a nucleotide chain.
- primitive** See plesiomorphic.
- prion** A proteinaceous infectious particle; it is an infectious agent that is virus-like but appears to lack nucleic acid and consists only of protein.
- probe** A term given to DNA that is labelled with radioactivity or other markers and hybridised to detect complementary DNA sequences.
- productivity** The rate at which biomass accumulates; primary productivity refers to productivity of producer organisms (e.g. plants).
- proglottid** The segment-like body unit of a tapeworm; new segments are added at the anterior end.
- programmed cell death (apoptosis)** The process of cell suicide that involves a characteristic series of events leading to death of the cell.
- prokaryote** A bacteria; small cells that lack membrane organelles such as a nucleus or mitochondria or chloroplasts; *compare* eukaryote.
- prokaryotic cell** A cell with a simple structure, lacking a nucleus and other internal membrane-bound organelles; a bacterial cell.
- prometaphase** A phase of mitosis in which the nuclear envelope breaks down, allowing the mitotic spindle to interact with and move chromosomes.
- promoter** The specific sequence of DNA that binds RNA polymerase, promoting initiation of transcription of the coding region.
- prophase** The initial phase of mitosis in which the mitotic spindle assembles and dispersed chromatin in the nucleus condenses into paired chromatids.
- proplastid** The precursor organelle of all types of plastids.
- prosoma** In arthropods, the anterior part of the body, the head or cephalothorax.
- prostomium** The anterior, presegmental part of an annelid (segmented worm), which houses the brain.
- protandry** In animals, a situation in which an individual starts life as a male changing to a female at some later stage; in plants, a condition where a flower first opens in the male phase (anthers dehisce) and later becomes female (stigmas receptive).
- Proteaceae** A southern hemisphere plant family that includes banksias and waratahs.
- protein** See polypeptide chain.
- proteoglycan** (pl. proteoglycans) An O-linked glycoprotein containing many sugar chains; it is produced in the Golgi apparatus from proteins containing serine, threonine or hydroxyproline residues; it matures to form surface slimes and mucus.
- proteoid root** A cluster of hairy rootlets in some Proteaceae and Fabaceae that forms a dense mat at the soil surface to enhance nutrient uptake in nutrient-poor soils.
- prothoracicotropic hormone** A protein secreted by neuroendocrine cells in the insect brain; it is the first in a suite of hormones that control the moulting process.
- protist** An eukaryote including unicellular, multicellular, photosynthetic and non-photosynthetic organisms; a member of the kingdom Protista, which is a diverse array of organisms excluding plants, fungi and animals, not a single evolutionary group.
- Protista** A kingdom of eukaryotes excluding plants, fungi and animals; it is not a monophyletic taxon.
- protogyny** In animals, a situation in which an individual starts life as a female, changing to a male at some later stage; in plants, a condition where a flower first opens in the female phase (stigma receptive) and later becomes male (anthers dehisce).
- proton** A positively charged particle of an atomic nucleus; a hydrogen ion.
- protonema** A mass of branched filaments that is the first gametophytic plant in the life cycle of a moss resulting from the germination of a haploid spore.
- protonephridium** (pl. protonephridia) The tubular excretory organ of animals that has a flame cell to filter coelomic fluid into the tubule for excretion.

- proto-oncogene** A normal cellular gene that when mutated leads to tumour formation.
- protoplasm** The cytoplasm and nucleus of eukaryotic cells.
- protostome** Animal in which the blastopore becomes the mouth (e.g. flatworms, annelids, molluscs, arthropods).
- Prototheria** A subclass of mammals with one order, the Monotremata (the echidna and the platypus); the only egg-laying mammals.
- protoxylem** The first formed and earliest maturing xylem tissue that forms towards the centre of the stem in plants.
- proximal convoluted tubule** The first part of the vertebrate nephron tubule, responsible primarily for reabsorption of solutes and water.
- proximate explanation** An explanation that considers the causation of a particular behaviour.
- pseudocoel** The body cavity of an animal, such as a nematode, that is not lined on all sides by mesoderm.
- pseudoplasmodium** A mass of amoebae that aggregate to form a 'slug' in the life cycle of a cellular slime mould; it is similar to the plasmodium of acellular slime moulds.
- pseudopodium** (pl. pseudopodia) The protrusion of part of the protoplasm of an amoeboid cell used for locomotion, ingestion of food, etc.
- Psilophyta** A phylum of fork ferns, the most primitive living vascular plants.
- psychrophile** An organism, such as a fungus, that can live in cold conditions.
- Pterygota** A class of insects; all have wings.
- pulmonary circuit** The pathway from the right ventricle of the heart to the lungs and back to the left atrium; it is responsible for oxygenating the blood.
- pulvinus** A motility organ at the base of the leaf petiole in certain plants, such as legumes, that controls the position of the leaf.
- pupa** A developmental stage in some insect life cycles between the larva and adult; non-feeding, immobile and sometimes encapsulated or in a cocoon.
- pure-breeding** Strains in which individuals and their progeny have the same phenotype.
- purine** A type of nitrogenous organic base (nucleotide), adenine and guanine, which pair with pyrimidine bases in DNA.
- purinotely** The pattern of nitrogenous waste excretion where excess nitrogen (mainly from digested protein) is excreted as purines (such as uric acid, guanine and xanthine).
- Purkinje fibres** A group of fast-conducting cells that stimulate the ventricles of the mammalian heart to contract; these cells originate from the atrioventricular bundle and radiate throughout the ventricle muscle.
- purple bacteria** A type of photoheterotrophic bacteria that uses sunlight for energy but ready-made organic compounds as building blocks; bacteria have a characteristic set of photosynthetic pigments different from plants.
- pygidium** The posterior, postsegmental part of an annelid.
- pygostyle** In modern birds, a plate-like structure formed from caudal (tail) vertebrae to which specialised tail feathers are connected.
- pyrimidine** A single ring molecule; it forms three of the bases of nucleic acids—cytosine, thymine and uracil.
- pyruvate** (C<sub>3</sub>H<sub>3</sub>O<sub>3</sub>) The end product of glycolysis.
- Q<sub>10</sub>** The measure of the sensitivity of biochemical processes to temperature, measured as the increase in the rate of a physiological process or reaction for a 10°C rise in temperature.
- quantitative trait locus** A locus that influences a polygenic phenotype.
- Quaternary period** The geological period from 1.8 million years ago to the present.
- quaternary structure** The specific association of several globular protein units to form a functional protein.
- r strategist** Species that are opportunists, with high population growth rates (*r*), large numbers and short life cycles (such as plant weeds or insect pests).
- radial canal** Extensions from the stomach of a medusa (jellyfish) radiating out to the margin of the bell; *see also* ring canal.
- radial symmetry** The symmetry of an organism such that any plane passing through the central axis bisects the organism into equal halves (e.g. jellyfish).
- radicle** The root axis of a germinating seed.
- radiometric dating** The quantitative determination of the level of radioactivity used as a method to date the geologic age of rocks and fossils.
- radula** A tongue-like structure, with rows of rasping teeth; it is present in the floor of the foregut of molluscs, except bivalves.
- ram ventilation** The flow of water or air used for ventilation that occurs by forward locomotion.
- random genetic drift** A random change in the frequency of alleles in a population over time.
- random mating** It occurs in a population if the polymorphic character being studied has no influence on the choice of mate.
- raphe** A longitudinal slit in the valve of a pennate diatom; it is associated with the gliding motion of diatoms.
- rate** Of a chemical reaction, velocity at which it proceeds towards equilibrium.
- ratite** An ancient group of flightless birds, including the living southern hemisphere emu, cassowary, kiwi, ostrich, tinamou, rhea and recently extinct moa; they lack a keel on the sternum.
- ray initial** A type of meristematic cell produced by the vascular cambium differentiating into wood rays.
- reabsorption** A physiological process in animals whereby solutes are actively transported from the urine or the gut contents back into body fluids.
- reaction centre** A specialised chlorophyll complex functioning as a photosynthetic unit capable of channelling energised electrons to an acceptor molecule; it is located on the thylakoid membranes of chloroplasts.
- realised distribution** Of a species; the range over which individuals live and reproduce.
- realised niche** A species' actual range of environmental factors in which it survives.
- receptacle** The fluid-filled beads of brown algae such as *Hormosira* that are resistant to drying; the stem of a flower to which all the parts are attached.
- receptor** A molecule, usually a protein, in the plasma membrane or within a cell, that undergoes a change as a result of a specific interaction with a signal, leading to a particular response.
- receptor tyrosine kinase** A transmembrane receptor that contains an extracellular ligand binding and dimerisation domain and an intracellular kinase domain that, when activated, phosphorylates the receptor and activates an intracellular signalling cascade.
- receptor-mediated endocytosis** The invagination of a membrane in response to the binding of specific molecules to receptors on the membrane surface, for the purpose of forming vesicles to enable bulk transfer of substances across the membrane.
- recessive** A phenotype, such as green colour in seeds, which is apparent in the homozygous (*yy*) individuals, but absent in the heterozygous (*Yy*) individuals.
- recombinant** An individual that exhibits different allele combinations than their parents due to recombination.
- recombinant DNA** Technology involving cutting DNA into fragments, joining them to foreign DNA and introducing them back into cells where they can be used to isolate and characterise particular short stretches of DNA or to express particular proteins.
- recombination** The mixing of alleles of different genes on homologous chromosomes (homologues), caused by crossing-over between homologues during meiosis.
- red alga** Common multicellular seaweed containing the pigment phycoerythrin (in addition to chlorophyll *a* and phycocyanin) which gives them a red colour.
- red tide** Discolouration of the sea caused by a population explosion of dinoflagellates, which may be toxic.
- redia** (pl. rediae) A larval stage in the life cycle of parasitic flukes that develops within sporocysts and that forms cercariae.
- reduced** When an atom or molecule accepts an electron.
- refractory period** The short period after a neuron has fired an action potential when it cannot be excited to fire another one.

- regeneration** A form of asexual reproduction involving the production and differentiation of new tissues of an organism.
- regulated secretion** Secretion that only occurs in response to a specific signal.
- regulative development** Development in which the fate of blastomeres is determined by interactions with surrounding cells.
- relative fitness** A measure of fitness in which the fitness of the fittest genotype is assigned a value of unity (one), and the fitness values for the other genotypes are adjusted proportionally.
- renal cortex** The outer layer of the mammalian and avian kidney, containing the glomeruli and proximal and distal convoluted tubules; it is responsible for solute and water reabsorption (but not osmotic concentration) and is equivalent to the kidney of lower vertebrates.
- renal medulla** The inner layer of the mammalian and avian kidney, containing the loops of Henle and collecting ducts; it is responsible for osmotic concentration of urine by counter-current multiplication.
- renin** An enzyme secreted by the macula densa cells of the juxtaglomerular apparatus of the mammalian kidney; it converts circulating angiotensinogen into angiotensin I (which is converted to angiotensin II in the lungs).
- repetitive DNA** DNA that contains the same nucleotide sequence multiple times in the genome.
- replication** The synthesis of DNA on a DNA template to produce two identical DNA molecules.
- replication fork** The point of separation of strands of duplex DNA where replication occurs.
- replicon** A unit region of replication in chromosomes of eukaryotes; from an origin, bidirectionally, to termination of DNA replication in both directions.
- repressor protein** A protein that binds to the operator sequence and prevents transcription initiation.
- reproduction** The production of a new individual; in plants, reproduction can occur either vegetatively or sexually.
- reproductive effort** The investment of parents in sexual reproduction, which is dependent on their own survival and future reproductive success.
- reproductive isolating mechanism** A geographical, physical, physiological or behavioural barrier preventing the interbreeding of individuals from different species or populations.
- reproductive success** The number of surviving offspring produced by an individual.
- Reptilia** A traditional class of vertebrates including snakes, lizards, crocodiles, etc., but a paraphyletic taxon.
- resistance** The ability to withstand an environmental impact, for example to ward off infection and disease, bacterial resistance to antibiotics.
- resistance vessel** An arteriole; these small vessels are surrounded with muscle that contracts to narrow the vessel diameter and restrict flow; they produce the major control over the distribution of blood in various tissues.
- resting membrane potential** The difference in electrical potential across a plasma membrane at electrochemical equilibrium.
- restoration** A process to produce (restore) a healthy, natural, self-regulating ecosystem to a state similar to that before human disturbance.
- restriction endonuclease (restriction enzyme)** An enzyme that recognises specific sequences within a double-stranded DNA molecule and cleaves the DNA.
- restriction fragment length polymorphism (RFLP)** A restriction fragment that differs in length in different individuals (i.e. it is polymorphic) because of differences in the DNA sequence.
- rete** A network of interdigitated arteries and veins that function for efficient countercurrent exchange.
- reticulopodium** A network of cytoplasmic strands that connect individual amoeboid cells of chlorarachniophytes (k. Protista).
- retrotransposon** A class of transposon related to retroviruses; *see* transposon and retrovirus.
- retrovirus** A virus with a genome of ssRNA, which upon infection, is transcribed into dsDNA and incorporated into the host cell's chromosomes to produce progeny virus ssRNA; includes HIV.
- reverse transcriptase** An RNA-dependent DNA polymerase (i.e. an enzyme that synthesises DNA from an RNA template).
- reversible binding** Respiratory pigments must be able to bind and release oxygen.
- rhabdite** A rod-like structure secreted by epidermal gland cells in free-living flatworms.
- Rhesus antigen** A human blood group antigen that may cause haemolytic reactions, especially during pregnancy; blood containing this antigen is called Rh positive, while that lacking it is Rh negative.
- rhinarium** The nose pad surrounding nostrils in groups of mammals.
- rhizoid** A short root-like structure that anchors bryophytes and some fungi to their substrate.
- rhizome** An underground stem.
- rhizomorph** Fungal hyphae growing together like rope with a tough, darkly pigmented outer sheath that makes them resistant to drying.
- rhizopod** An amoeba that is able to transiently produce extensions of the cell surface.
- rhizosphere** The soil zone immediately surrounding the root hairs in plant roots where interactions occur between plant, soil and microorganisms.
- rhodophyte** *See* red alga.
- rhodopsin** An important photoreceptor of animals, found in the rod cells of the retina of the vertebrate eye, associated with the chromophore retinal, which undergoes a chemical rearrangement after absorbing light.
- rhopalia** The sense organ of a jellyfish that contains a statolith or sometimes an eyespot.
- rhynchocoel** A coelomic body cavity that houses the proboscis of a proboscis worm (nemertine).
- Rhyniophyta** An extinct phylum of the earliest land plants; fossils date from the Silurian and Devonian periods
- ribose** A five-carbon sugar; a sugar component of RNA.
- ribose nucleic acid (RNA)** A single-stranded nucleic acid characterised by a ribose sugar in each nucleotide and the bases adenine, cytosine, thiamine and uracil; *see also* mRNA, rRNA and tRNA; it is involved in transcribing and translating coded information of DNA during the production of proteins.
- ribosome** A cytoplasmic organelle where protein synthesis occurs; it is formed from two rRNA subunits in association with an mRNA molecule.
- ribozyme** An RNA molecule that acts as an enzyme.
- ribulose biphosphate (RuBP)** The five-carbon sugar that binds to CO<sub>2</sub> in the first step of carbon fixation in photosynthesis.
- ribulose biphosphate carboxylase-oxygenase (Rubisco)** An enzyme that catalyses the first step of carbon fixation (*see* RuBP); it constitutes 50% of protein in chloroplasts.
- ring canal** A structure that runs around the margin of the bell of a medusa (jellyfish); it is linked to radial canals which extend from the stomach.
- root apical meristem** The meristem at the apex of a root.
- root cap** Parenchyma tissue covering a root tip; it secretes a mucigel to aid the root penetration through the soil; it usually contains numerous starch granules that may act as sensors of gravity.
- root nodule** The outgrowth of roots in a wide range of plants, especially legumes, in which symbiotic nitrogen-fixing bacteria (*Rhizobium* or *Frankia*) occur.
- root pressure** The positive pressure generated by roots that is responsible for the exudation of sap from tapped or cut stems in spring.
- Ross River alphavirus** An arbovirus (arthropod-borne) widespread in Australia that infects mammals and is spread by mosquitoes; in humans, it causes fever and joint swelling.
- rostellum** An apical protrusion of the tapeworm scolex that is armed at its base with hooks.
- rough endoplasmic reticulum (RER)** An endoplasmic reticulum with attached ribosomes; it is involved in synthesis of proteins usually destined for export from a cell.
- rowing** The action of propelling an object across or through a fluid using oars or oar-like appendages.
- ruminant** The regurgitation and re-chewing of partially digested food in mammals of the order

- Artiodactyla** Suborder Ruminantia—sheep, cattle and deer.
- rural dieback** The premature and usually rapid decline and death of native trees in rural Australia caused by a variety of factors.
- S phase** A phase of the cell cycle in which DNA replication occurs.
- sac-like gut** A part of the gut that is expanded into a voluminous sac that allows digesta to be subject to extensive mixing and fermentation.
- salt gland** A gland that can secrete a salt solution that is more concentrated than body fluids (e.g. reptiles, birds and mangroves).
- saltatory conduction** The conduction of action potentials along myelinated axons involving action potentials skipping from node to node.
- saprophyte** An organism that lives on dead organic matter.
- sapwood** The outer region of wood (secondary xylem) in a tree trunk containing living rays; of lesser strength than heartwood.
- sarcomere** A region of myofibril between adjacent Z-lines.
- Sarcopterygii** See coelacanth and lungfish.
- satellite DNA** DNA that contains large numbers of small nucleotide sequences repeated in tandem.
- satellite nucleic acid** A simple virus-like infectious agent; a genome of ssRNA circles of about 300–400 nucleotides in length; they rely on a helper virus for their proteins and transmission.
- satellite virus** A type of virus only able to replicate in cells infected with a specific helper virus.
- Sauropsida** One of the two major lineages of amniotes; it includes turtles, tuatara, lizards, snakes, crocodiles and birds; the other lineage (sister group) is the Mammalia.
- scavenger** An animal feeding on carrion (dead organisms).
- schistosomulum** A juvenile stage of the blood fluke, *Schistosoma*.
- scleireid** A plant cell with a thick, lignified wall; the stone cells of fruit, etc.
- sclerenchyma** Plant tissue that has a support role; cells with thickened lignified secondary walls that impart rigidity as well as strength; it includes sclereids, branched or more-or-less even-shaped stone cells that form the hard tissue of fruits and seed coats and fibres; elongate cells.
- sclerophyll** A plant characterised by rigid, often small leaves, and short internodes; able to survive low soil nutrients, water stress and fire.
- sclerotium** (pl. sclerotia) A hard, resistant resting body, composed of masses of tightly compacted mycelium, formed by some soil-inhabiting fungi.
- scolex** An anterior attachment organ, with suckers and often hooks, of a tapeworm.
- scutellum** The single cotyledon of monocotyledonous flowering plants; it forms an interface tissue between the embryo and endosperm.
- scyphistoma** The stage in the life cycle of a jellyfish (class Scyphozoa) that produces small medusae called ephyrae.
- Scyphozoa** A class of cnidarians; jellyfish.
- second law of thermodynamics** The entropy of the universe is increasing; thus an input of energy is needed to maintain the ordered state of the universe.
- second messenger** The small intracellular signalling molecule such as cyclic AMP and calcium ion, which are required for the activity of effector proteins such as ion channels or intracellular enzymes and whose concentration alters in response to receptor activation.
- secondary cell wall** An additional strengthening layer added to plants cell walls during development to make them more rigid; its main component is lignin.
- secondary lymphoid organ** An organ where the immune response is induced, for example the spleen and lymph nodes.
- secondary phloem** The phloem tissue formed from the vascular cambium during secondary growth.
- secondary response** The larger, more rapid immune response to a particular antigen as a result of immunological memory due to an earlier primary immune response.
- secondary structure** The structure of a protein that results from fold-backs ( $\beta$ -sheets) or coils ( $\alpha$ -helices).
- secondary xylem** The xylem tissue formed from the vascular cambium during secondary growth.
- secretin** A hormone released by gastrointestinal mucosa in response to acid into local blood vessels; the target organ is the pancreas where it acts to optimise the release of digestive secretions.
- secretion** The process by which cells release ions and/or biochemicals in solution, for example secretion of digestive enzymes, hormones, saliva and bile.
- seed coat (testa)** A protective layer that surrounds a seed; the seed coat develops from the integuments.
- seed dormancy** A condition of arrested growth; commencement of growth requiring special environmental cues.
- seed** A structure from which a new plant develops; it is produced from a fertilised ovule, containing an embryo, a food source (cotyledons or endosperm) and usually a hard outer seed coat (testa).
- segmentation gene** A gene required for segment formation.
- segment-polarity gene** A gene expressed in a portion of each segment and required for formation of proper segmental structures.
- selective permeability** The ability of membranes to allow passage of some molecules and not others.
- self-fertilisation** Fertilisation resulting from a self-pollination.
- self-incompatibility** A genetically controlled process preventing self-fertilisation; in flowering plants, the recognition of self-pollen leads to a rejection response usually in the style, while compatible pollen from another individual of the same species is accepted.
- self-pollination** Pollination by pollen from the same flower or by pollen from another flower on the same plant.
- self-thinning rule** When growing plants in a plot (e.g. a crop), the average weight of an individual becomes related to the density of survivors.
- semiconservative replication** The mode of DNA replication employed by living organisms, in which each strand of a DNA molecule is used as a template to produce two new DNA molecules, each of which contains one strand derived from the parent and one that is newly synthesised.
- semilunar valve** A bicuspid valve between the right ventricle and pulmonary artery in mammals.
- sensory neuron** A neuron that detects a sensory stimulus.
- sepal** In a flower, one of the outer floral leaves; together the sepals often provide protection to the flower during its development.
- septum** (pl. septa) A wall that divides, or partially divides, a structure or cavity; a cross-wall in fungal hypha; a septum dividing the ventricle of the heart.
- sequencing (nucleotides and amino acids)** Determining the order of amino acids in a polypeptide chain or of nucleotides in a DNA or RNA molecule.
- sere** The orderly sequence of ecological communities that replace one another over time.
- serum** The yellowish fluid isolated from clotted blood; plasma without some of the constituents bound to the clot.
- seta** (pl. setae) Chitinous bristle.
- sex** Often used as a synonym for sexual reproduction.
- sex chromosomes** Chromosomes that differ in morphology yet can pair and segregate during meiosis, are present in different numbers in males and females and are involved in sex determination.
- sexual reproduction** Formation of offspring by the fusion of haploid gametes from two different organisms.
- sexual selection** The differential ability of individuals to acquire mates; it involves contests between males or choice by females; it leads to the selection of morphological or behavioural traits relating to attracting mates.
- shoot apical meristem** The meristem at the apex of the shoot.
- short-day plant** A plant that will only flower if the daily period of light is shorter than some critical length—the period of continuous darkness to which the plant is exposed; plants that usually flower in spring or autumn.

- sieve tube** A series of sieve-tube cells arranged end to end and interconnected via sieve plates; it is responsible for the translocation of nutrients, especially sugars.
- signal** A stimulus, chemical (e.g. food or hormones) or physical (e.g. light or heat) that can be detected by cells leading to a particular response.
- signal sequence** A sequence within a protein that is recognised by a receptor within the cell so that the protein is targeted to a particular site within the cell.
- silencer** A sequence in a eukaryotic gene that binds transcription factors that repress transcription.
- silicoflagellate** A chrysophyte (golden flagellate) with a star-shaped silica skeleton.
- silk** An extracellular  $\beta$ -sheet protein with high strength and flexibility; it is secreted by spiders and moths.
- simple leaf** A leaf with a single lamina.
- simple pit** A pore in the secondary wall of some plant cells in which the pit diameter remains more-or-less constant.
- sinoatrial node** The heart's 'pacemaker'; a small group of non-contractible muscle cells in the right atrium of higher vertebrates that initiates the cardiac cycle; it is evolutionarily derived from the sinus venosus of fishes.
- sinus venosus** The first chamber of the fish heart that collects blood from the major veins and leads to the atrium.
- siphon** A specialised funnel in cephalopods that can produce a jet of water for propulsion.
- siphuncle** A structure that regulates the amount of gas and buoyancy in some cephalopods.
- sister chromatids** The identical copies of DNA and associated chromosomal proteins that result from DNA replication and are joined at the centromere until being separated at the onset of anaphase.
- slash-and-burn agriculture** A traditional agricultural practice involving the clearing of a small area of forest and burning the fallen timber, releasing nutrients to support a crop.
- sliding filament model** A model of mechanism of contraction of skeletal muscle, which proposes that the relative motion between actin and myosin myofilaments within muscle cells produces shortening of individual cells, resulting in muscle contraction.
- slime mould** Amoeboid protists that produce fruiting bodies and absorb nutrients from their environment in a way similar, but unrelated, to fungi.
- smallpox** A disease caused by variola virus (a poxvirus); a cause of death of many humans in the past with the virus spread mainly by rodents.
- smooth endoplasmic reticulum (SER)** Endoplasmic reticulum that lacks attached ribosomes.
- smooth muscle** Spindle shaped contractile cells with a central nucleus and less regular arrangement of myofilaments than striated muscle cells; it lines the walls of internal organs and arteries and veins and is under involuntary control.
- soil acidification** An induced increased soil acidity, for example by over use of fertilisers in agriculture.
- solute** A molecule dissolved in a liquid.
- solvent** The liquid medium in which a solute is dissolved.
- soma** The middle, segmented part of an annelid; the body of a neuron as distinct from the dendrites and the axons.
- somatic cells** All cells in the body of a multicellular organism other than germ cells.
- somatostatin** The peptide released by gamma cells of the islets of Langerhans; it appears to inhibit neighbouring  $\alpha$  and  $\beta$  cells in a paracrine fashion.
- somite** A block of mesoderm that forms adjacent to the notochord in the vertebrate embryo.
- soredium** (pl. soredia) A structure of a lichen analogous to a spore; it consists of an algal cell embedded in fungal hyphae.
- sporocarp** A fruiting body produced during the life cycle of slime moulds.
- sorus** (pl. sori) A cluster of sporangia on the margins or undersurface of a fern frond.
- space constant** The distance along a neuronal membrane that it takes for an applied voltage to fall to  $1/e$  (about 37%) of its original value.
- speciation** The formation of new species; *see* allopatric, sympatric and parapatric speciation.
- species** As a taxonomic category, the species is the lowest rank in a taxonomic classification (*see also* binomial system). There is no single definition that is agreed upon by evolutionary biologists. The biological species concept is a group of actually or potentially interbreeding natural populations that are reproductively isolated from other such groups.
- species richness** The number of species within a community.
- sperm competition** The competition for fertilisation success between the ejaculates of two or more males that are found simultaneously within a female's reproductive tract.
- sperm** The male gamete.
- spermatheca** (pl. spermathecae) A small sac containing sperm.
- spermatocyte** The male germ cell in the process of meiosis within the testis.
- spermatogenesis** The process by which sperm form from primordial germ cells.
- spermatogonium** A diploid male germ cell in the process of mitosis in the testis.
- spermatophore** A structure enclosing many sperm; *see also* spermatheca.
- S-phase-promoting factor** A specific cyclin and cyclin-dependent protein complex whose activity drives a cell from the G1 phase into the S phase.
- Sphenophyta** A phylum of horsetails, early vascular plants known mostly as fossils; one living genus *Equisetum*.
- spicule** The skeletal component in sponges, composed of calcium carbonate or silica.
- spinneret** The spinning organ that produces silk in spiders.
- spiracle** (pl. spiracles) The small external opening of the air-filled gas-exchange system (tracheae) of spiders and insects.
- splicing** The process whereby regions of RNA (introns) from the primary transcript are removed and flanking exons are joined.
- sponge** The simple marine animals (p. Porifera) that are ordered aggregations of cells but lack tissues or organs; they are characterised by collar cells; *see* choanocytes.
- spongin** The coarse collagenous proteinaceous material forming skeletal fibres in sponges.
- spongocoel** The internal cavity of a sponge; it is also called the atrium.
- spongy mesophyll** Irregularly arranged leaf mesophyll cells with conspicuous intercellular spaces.
- sporangiophore** The stalk of a fungus that bears a sporangiospore and spores.
- sporangiospore** A haploid asexual spore that develops in a sporangium.
- sporangium** A sac-like cell or multicellular structure in which asexual spores form.
- spore** A cell capable of producing a new individual; it is often a dormant resistant structure or functioning in dispersal.
- sporocyst** A sac-like structure in the life cycle of parasitic flukes that produces rediae.
- sporophyte** The diploid stage of a plant life cycle that produces spores.
- sporopollenin** A polymer, tougher than lignin but with similar properties, composed chiefly of carotenoids; it makes spores and pollen grains of plants resistant to biodegradation.
- sporozoite** The stage in the life cycle of the malarial parasite that has the apical complex (*see* apical complex) and passes from the salivary gland of the mosquito host to the vertebrate host blood stream.
- sporulation** The production of spores.
- stamen** In a flower, the male reproductive organ, comprising a bi-lobed anther on an elongated filament.
- starch** An insoluble polymer of glucose; composed of amylose (long chains of glucose units) and amylopectin (short branched chains of glucose); chief storage polysaccharide of green algae and plants; formed in chloroplasts and amyloplasts.
- Starling principle** In capillary exchange, the net fluid movement between the capillary and the interstitial fluid is determined by the balance between the hydrostatic pressure and the colloid osmotic pressure across the capillary wall.
- start** A stage of the cell cycle during the G1 phase in which a cell commits to progressing through the remainder of the cell cycle and dividing.

- statocyst** The balance organ.
- statolith** A small calcareous body found in sensory organs for balance.
- stele** The central vascular cylinder of stems and roots.
- stem cell** An undifferentiated cell that can divide continuously throughout the lifetime of an animal to produce cells that may proliferate and will differentiate to give rise to one or more specific cell types.
- stem** The main part of the aerial shoot of plants, usually bearing leaves, lateral branches and reproductive organs.
- sternum** The breast bone; in birds, it is enlarged with a bony keel for the attachment of pectoral muscles giving power for flight.
- steroid** The family of molecules that are derivative of polyisoprenoid lipids, with a multiple ring structure.
- stigma** The terminal cells of the pistil of a flower that receive and recognise pollen grains during interactions that may lead to fertilisation.
- stigma, of Euglena** A small red organ in the euglena cell involved in the detection of light.
- stipe** A stalk connecting the blades of a brown alga to the holdfast.
- stochastic model** A model (e.g. in population ecology) including chance, random variables.
- stolon** A horizontally growing stem or runner.
- stoma** (pl. stomata) A specialised pore in the epidermis of leaves and stems that allows uptake of CO<sub>2</sub> from the atmosphere for photosynthesis; the pore through which transpiration occurs.
- stomium** The zone of thin-walled cells where sporangia or anthers rupture to release spores or pollen grains.
- stonewort** The type of green alga, a charophyte, encrusted with calcite (CaCO<sub>3</sub>); it is related to land plants.
- storage parenchyma** The tissue of parenchyma cells containing storage reserves such as starch granules, lipid droplets or protein storage organelles.
- stratification** The process of exposing seeds to low temperatures for an extended period before attempting to germinate them at warmer temperatures.
- Strepsirhini** Lemurs and lorises, primates that have a naked rhinarium (nose pad) and nostrils that are slit-like (hence the name Strepsirhini).
- stress** A term used to describe a force acting on, or within, a body tending to deform it, that incorporates a measure of the area over which the force acts; it is usually measured in newtons (N) per square metre (m<sup>-2</sup>) (equals Pascals, Pa; where 1 N m<sup>-2</sup> = 1 Pa).
- striated muscle** A muscle with a highly organised array of actin and myosin filaments giving the appearance of cross-striations when viewed under the light microscope; includes skeletal and cardiac muscle.
- strobila** The tape or body of a tapeworm.
- strobilisation** Asexual reproduction in some animals; the process of splitting the body to produce small medusae in jellyfish; the process of adding new proglottids in the growth of a tapeworm.
- strobilus** (pl. strobili) In plants, a cone, which is a collection of sporangia; the body of a tapeworm.
- stroma (of chloroplast)** A matrix enclosed within an inner membrane.
- stroma (fungal)** A mat of fungal hyphae bearing spores.
- stromatolite** A concentrically layered rock, the layers being formed by the successive growth of thin mats of cyanobacteria; fossil and present-day.
- structural diversity** The diversity of a plant community measured in terms of the size and shape of plants irrespective of the species.
- style** The pathway for pollen tubes between stigma and ovary in the pistil of flowering plants; it may comprise solid transmitting tissue or a canal.
- subduction** The descent of sea floor back into the earth's mantle (at deep-sea trenches).
- substitution** A mutation in which a nucleotide in a particular position is changed to a different nucleotide.
- substrate** The reactants of a chemical reaction.
- substrate-binding amino acid** An amino acid whose R-groups lining the active site of an enzyme are concerned with the specific binding and orientation of substrate molecules.
- succession** The process of replacement over time of one ecological community by another.
- succulent** A xerophytic plant with fleshy leaves or stems and highly mucilaginous cell sap.
- sucker** An underground shoot that arises from the roots or lower stem of a plant and emerges from the soil as a new plant.
- sucrose** A disaccharide; the transport and storage form of carbohydrate (sugar) in plants.
- super kingdom** A domain; the highest grouping of living organisms (an informal taxonomic rank).
- supercooling** The cooling of a fluid so that it remains liquid below its nominal freezing point.
- surface tension** The surface tension at an air-liquid interface is the result of intramolecular attractive forces in the liquid, providing the potential energy that draws molecules from the surface and therefore shrinks the interfacial area.
- suspensor** A filament of cells below an embryo of flowering plants that connects it to the ovule.
- swim bladder** A gas-filled sac that forms as an outgrowth of the pharynx, allowing fishes to regulate buoyancy; homologous with lungs of land vertebrates.
- symbiosis** Interactions in which two organisms (symbionts) live together in a close relationship that is beneficial to at least one of them.
- symbiotic microorganism** As symbiosis refers to a relationship between two organisms in which both partners derive some benefit from the relationship, microorganisms that live naturally in the gut and that provide some benefit to the host animal are therefore symbiotic microorganisms.
- sympathetic nervous system** The division of the autonomic nervous system that innervates the enteric nervous system and controls vascular changes in organs.
- sympatric speciation** Populations specialising on different resources diverge and form new species without geographic isolation.
- symplast** The portion of a plant tissue constituted by the protoplasm and vacuoles of the tissue cells collectively.
- symplastic pathway** The pathway in plants for the uptake of water, solutes and ions from cell to cell via the cytosol; the only pathway for crossing the endodermis of roots.
- synapse** A small area of close contact between an axon terminal and a post-synaptic cell across which information is transmitted, usually by chemical neurotransmitters; it may be excitatory or inhibitory, and also electrical.
- synapsis** The pairing of homologous chromosomes during prophase of meiosis I.
- synaptic vesicle** A vesicle in the presynaptic terminal that contains transmitter chemicals.
- synaptonemal complex** The molecular scaffold on which crossing over occurs between paired chromosomes during prophase of meiosis I.
- synergid** In flowering plants, one of a pair of cells adjacent to the egg at the micropylar end of an embryo sac, one of which acts to receive the pollen tube.
- synonymous codons** Codons of different sequence that encode the same amino acid.
- systematics** The field of biology that studies the phylogenetic relationships and classification of organisms.
- systemic circuit** The pathway from the left ventricle of the heart to the body and back to the right atrium; it is responsible for delivering nutrients, etc., to the body.
- systole** The phase of the cardiac cycle involving a muscle contraction and ejection of blood from a heart chamber.
- T lymphocyte (T cell)** A lymphocyte that matures in the thymus and recognises antigen by means of the T cell receptor; it functions independently to kill microorganisms and controls B cell responses.
- tagma** (pl. tagmata) A structure formed by the fusion of segments in arthropods.
- tagmatisation** The organisation of segments into groups with differing structures and functions.
- tapetum** The inner layer of the anther wall of a flower, comprising cells dedicated to nutrition of the developing microspores.
- target cell** A cell that responds specifically to a particular hormone by means of specialised

receptor molecules located on the surface or inside the cell.

**taxon** Any formal name (rank) in the classification of living organisms (e.g. phylum, class, order, family, genus and species).

**taxonomy** The methods and principles of classification of organisms.

**T-cell receptor (TCR)** A dimeric receptor on a T-cell which recognises antigen epitopes presented by MHC.

**tegument** An outer, resistant body coat of parasitic animals such as flukes and tapeworms.

**teleomorph** The sexual form of a fungus.

**teleost** A ray-finned fish; a diverse group of 20,000 species, including catfishes, trout, cod, etc.

**telomerase** A RNA-dependent DNA polymerase that extends the 3' end of DNA molecules in chromosomes, which would otherwise shorten because of the strictly 5' to 3' activity of DNA polymerase and the requirement for an RNA primer.

**telomere** The DNA sequence at the ends of chromosomes of eukaryotes.

**telophase** The final phase of mitosis, in which new nuclear envelopes form, surrounding each of the two newly separated groups of chromosomes.

**telson** The posterior tagma (tail end) of arthropods, which bears the anus.

**template** A DNA strand on which a complementary DNA strand is synthesised.

**terminally differentiated** A cell that has ceased dividing and has irreversibly differentiated into a particular cell type.

**terminus** The sequence of DNA that terminates replication.

**territorial behaviour** Where an individual defends an area that contains a resource against other individuals.

**tertiary structure** The final, folded three-dimensional shape of a protein, either globular or extended rods (fibrous proteins).

**test** See *foram*.

**testcross** A cross to a homozygous recessive individual.

**testis** (pl. testes) Specialised organ in a male where the germ cells undergo differentiation into sperm and hormones are produced to regulate reproductive function.

**tetanus** A condition of skeletal muscle in which it produces a continuous maximal contractile force due to stimuli that cause repeated contraction without pause.

**tetrapod** A land vertebrate with four limbs ('four footed') with separate digits.

**thallus** Body of an alga, fungus or plant that lacks special tissue systems or organs.

**theory** A general principle based on hypotheses that have survived falsification tests and explain all the observations.

**Theria** A subclass of mammals that includes Metatheria (marsupials) and Eutheria (so-called placentals).

**thermals** The rising bodies of relatively warm air that are used by glider aircraft and some birds to gain height.

**thermophile** An organism that grows best in hot conditions between 30°C and 50°C.

**thermoreceptor** A type of receptor that detects heat or cold.

**threshold potential** The potential difference across a membrane at which certain voltage-dependent channels (usually sodium and occasionally calcium) increase their permeability.

**thrombin** An enzyme that converts soluble fibrinogen into insoluble filaments of fibrin during the formation of a blood clot.

**thrombocyte** A cell fragment in mammals (platelet) or a whole cell in other vertebrates, involved in blood clot formation by adhering to fibrin strands in a wound.

**thrombus** A blood clot.

**thylacine** A tasmanian tiger or marsupial wolf, *Thylacinus cynocephalus*; it is presumed extinct.

**thylakoid** The flattened disc-like sac that forms part of the internal membrane system of chloroplasts; the site of location of photosynthetic pigments.

**thylakoid membrane** The pigmented membrane of a thylakoid.

**thymus** A fleshy lymphoid organ sitting atop the heart in humans where T cells differentiate.

**thyrotoxicosis** A condition of elevated metabolic rate caused by excessive thyroid hormone activity.

**thyroxine (T4)** An inactive form of thyroid hormone; the major product of the thyroid gland; it is converted into active T3 in target cells.

**tight (occluding) junction** A connection that provides an impenetrable seal between adjacent cells and restricts the lateral movement of membrane components.

**time constant** The time taken for a voltage applied to a neuronal membrane to change the initial voltage to  $1 - 1/e$  of its original voltage (about 63%).

**tissue culture** The growth of individual cells or tissues of an organism in sterile culture.

**tobacco mosaic disease** A plant disease caused by the tobacco mosaic virus; it is spread via the sap of plants; it causes the mottling of tobacco leaves.

**tone** The continual nervous stimulation of an organ; in the circulation, for example, the vagus nerve can continually reduce the heart rate, or nervous stimulation of the arterioles can continually constrict them and reduce the flow rate.

**tonicity** The potential of a solution to move water by osmosis across a semipermeable membrane; it depends on the solute concentrations of the

solution and the relative permeability of the membrane.

**tonoplast** The semipermeable lipoprotein membrane that encloses the vacuole of a plant cell and separates the cytoplasm from the vacuole.

**totipotency** The ability of plant cells to regenerate a new plantlet from a single cell.

**toxin** A poisonous compound; a product of certain microorganisms, plants (ricin), snakes (venom) and poisonous fungi.

**trace element** A micronutrient required by plants in small amounts, such as iron, zinc and copper, to carry out various metabolic functions.

**trace fossil** The preserved tracks, such as footprints, of extinct organisms.

**trachea** (pl. tracheae) The tiny spirally ringed tube that carries air internally to cells in insects and some other arthropods; in mammals, the initial portion of the airway before it branches dichotomously into the bronchi leading to the lungs.

**tracheid** A type of conducting cell in the xylem of all vascular plants; see also vessel element.

**tracheole** The finest tube arising from an arthropod trachea, where gas exchange occurs directly with body tissues.

**trait** A characteristic or phenotype.

**transcription factor** A protein that interacts with the regulatory sequences of genes to control their transcription.

**transcription** The synthesis of RNA from a DNA template.

**transcription unit** A region of DNA from which an RNA molecule is transcribed.

**transduction** The conversion of external energy, such as sound or light, into electrical signals in a sensory neuron; the transfer of DNA from one bacterium to another by infection with a virus (bacteriophage), which results in gene transfer and genetic variation.

**transfer cell** A type of parenchyma cell in plants; it is characterised by primary wall ingrowths, resulting in the massive increase in the surface area of the plasma membrane, and allowing rapid transfer of molecules to adjacent cells, especially the vascular system.

**transferase** An enzyme that catalyses a reaction where a chemical group or molecular unit is moved from a donor substrate to an acceptor.

**transformation** The process of introducing DNA into a cell so that the DNA is stably maintained within that cell.

**transition** A base substitution (mutation) in DNA in which a pyrimidine or purine is replaced by another pyrimidine or purine respectively.

**transition state** The intermediate state in a chemical reaction when the substrate molecules are poised ready to react; in this state, the reactants are strained or distorted and electrons may flow, breaking or making bonds, a state described as transition state activation.

- transition state activation** See transition state.
- translation** The synthesis of a protein from a mRNA template.
- translocation** The transport of assimilates (sugar) in the phloem of vascular plants from the site of production in leaves (source) to other parts of the plant (sink).
- transpiration** The loss of water from a plant by evaporation through stomata in leaves; requiring energy from incoming solar radiation to vaporise water.
- transport ATPase** A transmembrane protein that couples the hydrolysis of ATP to the transport of a molecule across the membrane.
- transposable element** A segment of DNA that has the capacity to transpose to new sites within the genome.
- transposon** Regions of DNA that exist in multiple copies and which can move around from chromosome to chromosome.
- transverse flagellum** See dinoflagellate.
- transverse septum** The tissue (septum) that divides the annelid coelom internally into segments.
- transversion** A base substitution (mutation) in DNA in which a pyrimidine is replaced by a purine or vice versa.
- Trematoda** A class of platyhelminths (flatworms); endoparasitic flukes.
- triacylglycerol** A simple lipid (neutral fat or oil); an ester of glycerol and three long-chain fatty acids.
- trichome** An outgrowth of the plant epidermis, such as simple hairs, stinging hairs, glandular hairs, scales and vesicles.
- tricuspid valve** The valve between the right atrium and right ventricle in the heart of mammals.
- triiodothyronine (T3)** An active form of thyroid hormone; it stimulates growth and development in immature vertebrates and metabolic rate in mature vertebrates.
- trilobite** A extinct group of arthropods with hard skeletal parts; the most common marine multicellular animal of the early Cambrian.
- triple fusion nucleus** During double fertilisation, the product of fusion between the central cell from the embryo sac and one of the two sperm cells from the pollen tube; the product of this fusion develops into the endosperm.
- trochophore** The free-swimming ciliated larva typical of protostome animals such as polychaetes.
- trophic level** The position of an organism in a food chain (e.g. primary producer or first-order consumer).
- trophozoite** The stage in the life cycle of the malarial parasite in which it eats the contents of the red blood cells of the vertebrate host; trophozoites divide regularly and induce lysis of the red blood cells, causing the release of toxins and the periodic fever and chills of malaria.
- trypanosome** A kinetoplast, unicellular flagellate parasite; it causes African sleeping sickness and Chaga's disease; it is transmitted by blood-sucking insects.
- tube feet** A short, tubular, external projection of the body wall of echinoderms containing an extension of the radial canals of the water vascular system; it functions in gas exchange, attachment, locomotion and catching prey.
- tube nucleus** The nucleus of the pollen tube.
- tuber** A thickened, fleshy, underground root (e.g. *Dahlia*) or underground stem (e.g. potato), which functions as a storage organ.
- tubular floret** A type of flower in a daisy head (usually towards the centre) that has fused.
- tubulin** A protein that forms the major cytoskeletal scaffolding elements, microtubules; it is composed of equal amounts of two forms:  $\alpha$ - and  $\beta$ -tubulin.
- tumour suppressor gene** A normal cellular gene that, when made non-functional by mutation, leads to tumour formation.
- tunic** A supportive and protective 'coat' of tunicates secreted by the ectoderm.
- tunica** In the shoot apex of flowering plant, the outer one to three layers of the apical dome of cells that contributes to leaf and flower formation.
- Turbellaria** A class of platyhelminths; free-living flatworms.
- turgor** The pressure developed within a walled cell due to the uptake of water by osmosis.
- turgor pressure** The hydrostatic pressure within a cell that has a cell wall.
- twitch** A single, usually relatively rapid, transient force produced by muscle activation following a short duration stimulus.
- ultimate explanation** An explanation that is concerned with the evolution and function of a particular behaviour.
- undulatory swimming** The propulsion of an animal through water as a result of a sinusoidal wave motion propagated along the length of the body or parts of the body (e.g. the fins of some fishes).
- unipotent** Stem cells that produce only one type of cell, for example, skin stem cells.
- uniramous** Unbranched limbs, such as occur in insects.
- urediniospore** An asexual spore of a rust fungus.
- ureo-osmoconform** The pattern of iono- and osmo-regulation in marine vertebrate animals where body fluids are maintained at a lower ion concentration than seawater but at the same osmotic concentration, with the 'osmotic gap' filled mainly by urea.
- ureotely** The pattern of nitrogenous waste excretion where excess nitrogen (mainly from digested protein) is excreted as urea.
- ureter** The drainage duct of the kidney that leads to a storage bladder or directly to an excretory pore.
- uricotelly** The pattern of nitrogenous waste excretion where excess nitrogen (mainly from digested protein) is excreted as the purine, uric acid.
- Urochordata** A subphylum of chordates; tunicates or sea squirts.
- vaccination** A deliberate infection (e.g. a strain of smallpox virus) to give stable immunity to a disease; immunisation.
- vaccine** A preparation of bacteria or virus rendered harmless and administered in order to induce immunity to subsequent infection.
- valve, of diatoms** See frustule.
- van der Waals force** A weak attractive force between two polar atoms or molecules; it arises due to the non-uniform distribution of electric charge at any instant on an atom.
- variable numbers of tandem repeats (VNTRs)** Segments of DNA that differ between individuals because they have different numbers of direct repeats at a particular locus.
- variation** Differences in the phenotype or genotype of individuals in a population; phenotypic variation that has an underlying genetic basis is the type of variation that can lead to evolution.
- varicella zoster herpesvirus** The cause of the diseases chickenpox and shingles; a type of herpesvirus.
- vascular bundle** A prominent structural feature of primary growth in shoots, roots and leaves, comprising the transport system; it consists of xylem and phloem.
- vascular cambium** A meristem responsible for producing wood (secondary xylem and secondary phloem).
- vasomotor centre** The centre in the brain that controls the pressure and distribution of blood by affecting the contraction of smooth muscle in arterioles.
- vasopressin** A posterior pituitary (antidiuretic) hormone that influences blood pressure and water balance.
- vector** An agent, such as an insect, able to transfer a pathogen from one organism to another.
- vector DNA** DNA that carries an origin of replication and a selectable marker gene into which segments of donor DNA are ligated to create recombinant DNA that can be propagated in a host cell.
- vegetal plate** The first sign of gastrulation; a flattening of the vegetal pole region caused by a lengthening of epithelial cells.
- vegetative cell** The largest cell of a pollen grain that contains the generative cell and, in some cases, the sperm cells, and produces the pollen tube at pollen germination.
- vein** In animals, a large blood vessel channelling blood towards the heart; in vascular plants, a network of vascular bundles in the leaf lamina.
- veliger** The second stage in the life cycle of molluscs; it develops from the larva and forms a foot, mantle and shell.

- ventricle** A heart chamber with strong muscular walls that develops most of the force necessary to pump blood through the circulatory system.
- venule** Small blood vessels that collect blood from the capillaries.
- vernalisiation** The induction of flowering in certain plants by exposure to low temperatures.
- vertebra** (pl. vertebrae) A segment of backbone.
- vertebrate** A chordate animal (superclass Gnathostomata) that has a backbone composed of vertebrae, which develop around and replace the notochord during development.
- vesicle-mediated transport** The bulk movement of substances across a membrane following the formation of membrane sacs that enclose the substances.
- vessel** A series of vessel elements arranged end to end in which the end walls become partially or totally perforated to form a tube-like structure.
- vestigial organ** A reduced and simpler structure than a corresponding part in another organism but with no apparent function; it indicates relatedness of organisms.
- virion** A complete mature virus particle, which is metabolically inert and is the transmission (infective) phase.
- viroid** An infectious agent that is virus-like but lacks a protein coat.
- virus** A subcellular genetic parasite that reproduces only in the cells of a susceptible host and may cause disease.
- vitelline membrane** A tough, clear, elastic envelope found in many eggs and embryos; it lies adjacent to the cell membrane.
- viviparity** A mode of sexual reproduction in animals in which offspring develop inside the maternal body and are released as live young or eggs; in plants, seeds germinate while still attached to the parent plant (e.g. in mangroves).
- voltage-gated channels** Membrane ion channels that open or close in response to changes in voltage across the membrane.
- Wallace's Line** The line dividing the Indo-Malaysian and Austro-Malaysian faunas; it runs between Bali and Lombok in the south and Borneo and Sulawesi in the north.
- water cycle** The circulation of water through ecosystems on earth, the atmosphere, precipitation, soil, ground water, waterways and oceans.
- water potential** The total energy level of water, which is the sum of the osmotic potential and pressure potential of water.
- water vascular system** A system of coelomic canals, lined with ciliated cells and filled with fluid; includes a circular water canal and radial canals leading to tube feet; it is unique to echinoderms; *see also* tube feet.
- water-use efficiency** The quantity of carbon assimilated by a plant compared to the quantity of water lost by it during transpiration over the same period.
- wax** Esters of fatty acids with long-chain monohydric alcohols; the water-repellent coating on plant leaves, animal fur, etc.
- weed** A plant growing where it is not wanted; often an introduced species.
- West Nile flavivirus (WNV)** An arbovirus (arthropod-borne) related to yellow fever; it is widespread in Africa but also occurs in other countries such as the US; it kills birds and some humans.
- wild-type** The phenotype found in most individuals in a population.
- windkessel vessel** A large artery near the heart; its walls contain elastin and muscles that stretch during ejection of blood into them when the ventricle contracts (systole); during ventricular relaxation (diastole), the energy in the stored wall is transferred back into blood pressure; this damps the pressure oscillations from the heart and keeps arterial blood pressure somewhat steady.
- xerophyte** A plant tolerant of dry conditions.
- xerotolerance** The tolerance of dry conditions.
- xylem** A major tissue of vascular plants comprising several cell types, including water-conducting vessels and tracheids, sclerenchyma fibres for support and parenchyma.
- yeast artificial chromosome (YAC)** A vector used to generate recombinant DNA molecules that carry very large genomic fragments.
- zeatin** A natural cytokinin isolated from maize.
- zoochlorellae** *See* zooxanthella.
- zooxanthella** (pl. zooxanthellae) Dinoflagellate endosymbiont found in the tissues of corals, sea anemones and molluscs.
- zygomorphic** A flower with parts arranged asymmetrically.
- Zygomycota** A phylum of fungi with coenocytic hyphae, for example the bread mould *Rhizopus*.
- zygospore** A dormant spore with a thick cell wall enclosing a zygote.
- zygote** A diploid cell resulting from the fusion of the male and female gametes.
- zygotic gene** A gene that is transcribed and acts in the developing zygote.