

Cell Biology (Biol 2221) Vocabulary List

The following is a useful words collected from the prerequisite courses for Cell Biology 2221 (words may be added continuously).

Block I

acid - a molecule that releases H⁺ ion (proton)

ATP (adenosine triphosphate) - a triphosphate ester of adenine that participates in the transfer of energy in hundreds of individual cellular reactions.

α -helix - A secondary structural motif of proteins in which a linear sequence of amino acids folds into a right-handed helix stabilized by internal hydrogen bonding between backbone atoms.

amino acids - serve as the subunits for proteins and consist of both a carboxylic acid group as well as an amino acid group.

base - a molecule that accepts H⁺ ion (proton)

β sheet - A planar secondary structure element of proteins that is created by hydrogen bonding between the backbone atoms in two different polypeptide chains or segment of a single folded chain.

chromosomes - structure composed of a very long DNA molecule and associated proteins that carries part (or all) of that hereditary information of an organism.

coenzymes - Small molecule tightly associated with an enzyme that participates in the reaction that the enzyme catalyzes, often by forming a transient covalent bond to the substrate.

complementary base pairs - base-pairing between a larger purine base (adenine or guanine) and a smaller pyrimidine base (cytosine or thymine) while DNA is in its double-helix. (A=T, G/C)

coupled reactions - linked pair of chemical reactions to which the free energy released by one of the reactions serves to drive the other.

cyclic AMP - serves as a universal signaling molecule; a secondary messenger in signaling pathways.

cytoplasm - contents of a cell that are contained within its plasma membrane but, in the case of eucaryotic cells, outside the nucleus.

cytoskeleton - system of protein filaments in the cytoplasm of a eucaryotic cell that gives the cell shape and the capacity for directed movement.

cytosol - contents of the main compartment of the cytoplasm, excluding membrane-bounded organelles such as endoplasmic reticulum and mitochondria.

dark reaction - in photosynthesis, the ATP and NADPH are used to drive a series of Acarbon-fixation @ reactions in which CO₂ from the air is used to form sugar molecules.

dehydration - also called *condensation*; a typical biosynthetic reaction in which two monomers, A and B, are to be joined

disulfide bond - covalent intrachain bonds found in protein molecules; covalent linking of two -SH groups of neighboring cysteine residues in a folded polypeptide chain. These bonds are **rarely, if ever** found in the cytosol.

DNA polymerase - catalyzes the addition, of a deoxyribonucleotide to the 3' end of a DNA chain.

DNA transcription - process in which molecules of RNA are synthesized in which a strand of DNA acts as a template.

dolichol - special lipid molecule that holds precursor oligosaccharides, prior to addition to proteins in the ER membrane

domain - certain combinations of α helices and β sheets which pack together to form a compactly folded globular unit.

electron-transport chain - movement of electrons from a higher to a lower energy level along a series of electron carrier molecules, as in oxidative phosphorylation and photosynthesis.

endoplasmic reticulum - labyrinthine, membrane-bounded compartment in the cytoplasm of eucaryotic cells, where lipids are synthesized and membrane-bound proteins are made.

enzymes - highly specific protein catalysts, they speed up the reactions by reducing the activation energy for a particular chemical change.

free energy(ΔG) - energy that can be extracted from a system to drive reactions. Takes into account changes in both energy and entropy.

glycogen - polysaccharide composed exclusively of glucose units used to store energy in *animal* cells. Large granules of glycogen are especially abundant in the *liver and muscle* cells.

glycolipid - membrane lipid molecule with a short carbohydrate chain attached to a hydrophobic tail.

glycolysis - the degradation of carbohydrates in a sequence of enzymatically catalyzed steps.

glycoprotein - any protein with one or more covalently linked oligosaccharide chains. Included most *secreted proteins* and most proteins exposed on the *outer surface of the plasma membrane*.

glycosidic bond - The carbon that carries the aldehyde or the ketone can react with any hydroxyl group on a second sugar molecule to form a glycosidic bond

Golgi apparatus - membrane-bounded organelle in eucaryotic cells where the proteins and lipids made in the endoplasmic reticulum are modified and stored.

hydrogen bond - bonds formed by polarized molecules (δ^+ δ^-), i.e. water.

hydrolysis - reaction in which water breaks the covalently linked compound A-B

hydrophilic - water "loving," hydrophilic molecules are soluble in water.

hydrophobic - water "fearing," hydrophobic molecules are quite insoluble in water

ionic bond - non-covalent bond; ionic interactions occur either between fully charged groups (ionic bond) or between partially charged groups

light activated reaction - in photosynthesis, the visible radiation impinging on a pigment molecule drives the transfer of electrons from water to NADPH and at the same time provides the energy needed for the synthesis of ATP.

limit of resolution - the limiting separation at which two objects can still be seen as distinct.

lysosomes - membrane-bounded organelle in eucaryotic cells containing digestive enzymes, which are typically most active at the acid pH found in the lumen of lysosomes

macromolecule - molecule such as a protein, nucleic acid, or polysaccharide with a molecular mass greater than a few thousand daltons

mitochondria - membrane-bounded organelle, about the size of bacterium, that carries out oxidative phosphorylation and produces most of the ATP in eucaryotic cells.

monosaccharides - the simplest of all sugars; compounds with the general formula $(\text{CH}_2\text{O})_n$, where n is an integer from 3 through 7. i.e. glucose ($\text{C}_6\text{H}_{12}\text{O}_6$), $n=6$. The addition of more than one monosaccharide via a covalent bond results in **oligosaccharides**. **Polysaccharides** are molecules with thousands of monosaccharide units.

mutation - a change in the DNA sequence that constitutes a genetic mistake.

nucleosides - compound composed of a purine or pyrimidine base linked to either a ribose or deoxyribose sugar. DNA and RNA are *not* polymers of nucleosides.

nucleotides - serve as building blocks for the construction of nucleic acids. Nucleoside with one or more phosphate *group* joined in ester linkages to the sugar moiety. DNA and RNA are polymers of nucleotides. Nucleotide \neq nucleoside.

nucleus - prominent membrane-bound organelle in a eucaryotic cell, containing DNA organized into chromosomes.

osmosis - movement of solvent from low concentration of solute molecules to high concentration of solute molecules. The solvent moves from a hypotonic to a hypertonic solution. The two solutions that have identical solute concentrations are said to be isotonic.

oxidation - removal of electrons

oxidative phosphorylation - the last step in catabolism and the point at which the major portion of metabolic energy is released.

phosphodiester linkage - covalent bond that joins the 5' and 3' carbon atoms to form nucleic acids

peroxisomes - small membrane-bounded organelle that uses molecular oxygen to oxidize organic molecules.

phospholipid - the major category of lipid molecules used to construct biological membranes. Generally composed of two fatty acids linked through glycerol phosphate to one of a variety of polar groups.

photosynthesis - conversion of light energy (sunlight) to chemical energy (glucose) through several enzymatically catalyzed steps: energy + CO₂ + H₂O → 6 sugar + O₂

proteases - enzymes, such as trypsin, that degrades proteins by hydrolyzing some of their peptide bonds.

protein kinases - Enzyme that transfers the terminal phosphate group of ATP to a specific amino acid of a target protein

proteins - long linear polymers of amino acids joined head to tail by peptide bond between carboxylic acid group of one amino acid to the amino group of the next.

proteoglycans - molecules consisting of one or more glucosaminoglycan (GAG) chains attached to a core protein

reduction - addition of electrons

ribosome - a complex of more than 50 different proteins associated with several structural RNA molecules (rRNA's)

RNA splicing - RNA-processing step in which all of the *intron* sequences are removed and *exon* sequences are kept thereby producing a much shorter RNA molecule.

second law of thermodynamics - the degree of disorder in the universe can only increase

side chain - group attached to α -carbon of amino acid and give the amino acid its chemical properties.

starch - polysaccharide composed exclusively of glucose units, used as an energy store in *plant cells*.

steroids - hydrophobic molecule related to cholesterol. Many important hormones are steroids.

triglyceride - glycerol ester of fatty acids. The main constituent of fat droplets in animal tissues (where fatty acids are saturated) and of vegetable oil (where fatty acids are mainly, unsaturated).

transition state - structure that forms transiently in the course of a chemical reaction and has the highest free energy of any reaction intermediate; a rate-limiting step in thereaction.

van der Waals attractions - at very short distances, any two atoms show a weak bonding interaction due to their fluctuating electrical charges. However, two atoms will very strongly repel each other if they are brought too close together. This latter phenomena is known as *van der Waals repulsions*.

It would be helpful to be familiar with the following 20 amino acids as well as which group each one is in:

Basic Side Chains

Amino Acid Side Chains

lysine $(\text{CH}_2)_5\text{NH}_3^+$
arginine $(\text{CH}_2)_3\text{NHCNH}_2\text{NH}_3$
histidine $\text{CH}_2\text{C}_3\text{N}_3\text{H}_4^+$

Acidic Side Chains

Amino Acid Side Chain

aspartic acid CH_2COO^-
glutamic acid $(\text{CH}_2)_2\text{COO}^-$

Uncharged Polar Side Chains

Amino Acid Side Chain

asparagine CH_2CONH_2
glutamine $(\text{CH}_2)_2\text{CONH}_2$
serine CH_2OH
threonine $\text{CH}_2\text{CH}_3\text{OH}$
tyrosine $\text{CH}_2(\text{C}_6\text{H}_5)\text{OH}$ $\text{C}_6\text{H}_6 = \text{benzene}$

Nonpolar Side Chains

Amino Acid Side Chain

glycine H

alanine CH₃

valine CH(CH₃)₂

leucine CH₂CH(CH₃)₂

isoleucine CHCH₃CH₂CH₃

proline (CH₂)₃

phenylalanine CH₂(C₆H₆)

methionine (CH₂)₂SCH₃

tryptophan *see diagram in text*

cysteine CH₂SH

Block II

action potential - rapid, transient, self-propagating electrical excitation in the plasma membrane of a cell such as a neuron or muscle cell

active transport - movement of a molecule across a membrane or other barrier driven by energy other than that stored in the concentration gradient or electrochemical gradient of the transported molecule

axon - long nerve cell processes that is capable of rapidly conducting nerve impulses over long distances so as to deliver signals to other cells

carrier proteins - membrane transport protein that binds to a solute and transports it across the membrane by undergoing a series of conformational changes

Channel proteins - form hydrophilic pores that extend across the lipid bilayer; when these pores open, they allow specific molecules to pass through them

cholesterol - lipid molecule with a characteristic four-ringed steroid structure that is an important component of the plasma membranes of animal cells

chromatography - technique generally most useful for protein fractionation and developed to separate small molecules such as sugars and amino acids.

dendrite - extension of a nerve cell, typically branched and relatively short, that receives stimuli from other nerve cells

electrochemical gradient - driving force that causes an ion to move across a membrane due to the combined influence of a difference in its concentration on the two sides of the membrane and the electrical charge difference across the membrane

electrophoresis - separation technique in which an electric field is applied to a solution containing a protein molecule; the protein will migrate at a rate depending on its net charge and on its size and shape.

integral membrane proteins - proteins that are tightly bound to the membrane and cannot be released from the membrane

liposomes - synthetic bilayer in the form of a spherical vesicle

membrane potential - voltage difference across a membrane due to a slight excess of positive ions on one side and of negative ions on the other

membrane transport - movement of molecules across a membrane mediated by a membrane transport protein

microvillus - thin cylindrical membrane-covered projection on the surface of an animal cell containing a core bundled of actin filaments. They are present especially large numbers on the absorptive surface of intestinal epithelial cells

neuron (nerve cell) - cell with long processes specialized to receive, conduct, and transmit signals in the nervous system

passive transport (facilitated diffusion) - movement of a molecule across a membrane down its concentration gradient

peripheral membrane proteins - proteins that can be released from the membrane

plasma membrane - encloses the cell, defines its boundaries, and maintains the essential differences between the cytosol and the extracellular environment

transmembrane proteins - amphipathic proteins that extend through the bilayer with part of their mass on both sides of the bilayer

Block III

acetyl coenzyme A (acetylCoA) - small water-soluble molecule that carries acetyl groups in cells.

base excision repair - a repair pathway for errors made in DNA replication

carbon fixation cycle (Calvin-Benson cycle) - process by which green plants incorporate carbon atoms from atmospheric carbon dioxide into sugars. This is the second stage of photosynthesis.

chlorophyll - light-absorbing pigment that plays a central part in photosynthesis

chloroplast - specialized organelle in green algae and plants that contains chlorophyll and performs photosynthesis

citric acid cycle (Krebs cycle or tricarboxylic acid cycle) - central metabolic pathway found in all aerobic organisms. Oxidizes acetyl groups derived from food molecules to CO₂ and H₂O. Occurs in the mitochondria of eucaryotic cells.

codon - sequence of three nucleotides in a DNA or messenger RNA molecule that represents the instruction for incorporation of a specific amino acid into a growing polypeptide chain.

complementary DNA (cDNA) - DNA molecule made as a copy of mRNA and therefore *lacking* the *introns* that are present in genomic DNA

cristae - folds of the inner mitochondrial membrane

DNA helicase - an enzyme that participates in DNA replication by unwinding the double helix near the replication fork

DNA ligase - fills in nicks and gaps made in polynucleotide strands

DNA renaturation (hybridization) - process whereby two complementary nucleic acid strands form a double helix during an annealing period; a powerful technique for detecting specific nucleotide sequences

DNA topoisomerases - enzymes that make reversible cuts in a double helical DNA molecule for the purpose of removing knots or unwinding excessive twists

endonucleases - enzymes that hydrolyze internal phosphodiester bonds in a polynucleotide chain or nucleic acid molecule

glycogen - polysaccharide composed exclusively of glucose units used to store energy in animal cells

heterogeneous nuclear RNA (hnRNA) - RNA transcripts freshly synthesized by RNA polymerase II in the nucleus; also known as *primary RNA transcript*

lagging strand - one of the two newly made strands of DNA found at the replication fork. The lagging strand is made in discontinuous lengths that are later joined covalently

leading strand - one of the two newly made strands of DNA found at the replication fork. The leading strand is made by continuous synthesis in the 5'-3' direction

mRNA - RNA molecule that specifies the amino acid sequence of a protein

nucleolus - structure in the nucleus where ribosomal RNA is transcribed and ribosomal subunits are assembled

Okazaki fragments - short lengths of DNA produced on the lagging strand during DNA replication

photosystems - multiprotein complexes that catalyze the conversion of the light energy captured in excited chlorophyll molecules to useful forms

poly-A tail - addition made to RNA polymerase II's transcript; aids in the export of mature mRNA from the nucleus, affects the stability of at least some mRNAs in the cytoplasm, and seems to serve as a recognition signal for the ribosome that is required for efficient translation of mRNA

polymerase chain reaction (PCR) - technique for amplifying specific regions of DNA by multiple cycles of DNA polymerization, each followed by a *brief heat treatment to separate complementary strands*.

polyribosomes (polysomes) - mRNA molecule to which are attached a number of ribosomes engaged in protein synthesis.

primosome - unit formed on the lagging strand comprised of a primase molecule and helicase

promoter - nucleotide sequence in DNA to which RNA polymerase binds to begin transcription

redox potential, E - a measure of an electron carrier's affinity for electrons

replication fork - Y-shaped region of replicating DNA molecule at which the two daughter strands are formed and separated

respiratory chain - the name given to the electron-transport chain in the mitochondria

restriction map - diagrammatic representation of a DNA molecule indicating the sites of cleavage by various restriction enzymes

restriction nucleases - one of a large number of nucleases that can cleave a DNA molecule at any site where a specific short sequence of nucleotides occurs

ribosomes - particle composed of ribosomal RNAs and ribosomal proteins that associates with messenger RNA and catalyzes the synthesis of protein

rRNA - any one of a number of specific RNA molecules that form part of the structure of a ribosome and participate in the synthesis of proteins.

RNA polymerase - enzyme that catalyzes the synthesis of an RNA molecule on a DNA template from nucleoside triphosphate precursors

RNA polymerase I - makes the large ribosomal RNAs

RNA polymerase II - transcribes genes whose RNA's will be translated into proteins

RNA polymerase III - makes a variety of very small, stable RNAs including 5s ribosomal RNAs and transfer RNAs

RNA primers - primers used to synthesize DNA strands by acting as a template

RNA splicing - process in which intron sequences are excised from RNA molecules in the nucleus during formation of messenger RNA

single-stranded binding proteins (SSB) - bind to exposed DNA strands without covering the bases; they aid helicase by stabilizing the unwound, single-stranded conformation

small ribonucleoproteins (snRNPs) - complexes of proteins with small RNAs contained in the nucleus; individually, they recognize specific nucleic acid sequences through RNA-RNA base-pairing

Southern blotting - technique in which DNA fragments, separated by electrophoresis, are immobilized on a paper sheet; specific molecules are then detected with a labeled nucleic acid probe

thylakoids - flattened sac of membrane in a chloroplast that contains pigment and carries out the light-gathering reactions of photosynthesis

tRNA - set of small RNA molecules used in protein synthesis as an interface (adapter) between mRNA and amino acids.

Block IV

action potential - rapid, transient, self-propagating electrical excitation in the plasma membrane of a cell such as a neuron or muscle cell

connective tissues - any supporting tissue that lies between other tissues and consists of cells embedded in a relatively large amount of extra-cellular matrix

cyclic AMP (cAMP) - nucleotide that is generated from ATP in response to hormonal stimulation of cell-surface receptors

depolarization - a shift in the membrane potential to a less negative value; triggered by an action potential

epithelial tissues (epithelium) - cells tightly bound together into sheets

endocrine cell - specialized animal cell that secretes a hormone into the blood; usually part of a gland, such as the thyroid or pituitary gland

glial cells - supporting cells of the nervous system, including oligodendrocytes and astrocytes in the vertebrate central nervous system and Schwann cells in the peripheral nervous system

myelin sheath - insulating layer of specialized cell membrane wrapped around vertebrate axons; produced by the oligodendrocytes in the central nervous system (CNS)

neurotransmitter - small signaling molecule secreted by the presynaptic nerve cell at a chemical synapse to relay the signal to the postsynaptic cell. Examples include acetylcholine, glutamate, GABA, glycine, and many neuropeptides

receptor - protein that binds to specific extracellular signaling molecule (ligand) and initiates a response in the cell. Cell-surface receptors such as the acetylcholine receptor and the insulin receptor, are located in the plasma membrane, with their ligand-binding site exposed to the external medium. Intracellular receptors, such as steroid hormone receptors, bind ligands that diffuse into the cell across the plasma membrane.

Schwann cell - glial cells responsible for forming myelin sheaths in the peripheral nervous system (PNS)

synapses - communicating cell-cell junction that allows signals to pass from a nerve cell to another cell

voltage-gated cation channels - contained in the membrane of all electrically excitable cells; responsible for generating the action potentials

Block V

AIDS - Acquired Immune Deficiency virus

allergy - 'changed reactivity' of the host when meeting an 'agent' on a second or subsequent occasion mediated by IgE

antibodies - a molecule produced by animals in response to antigen which has the particular property of combining specifically with the antigen which induced its formation

antigen - a molecule which reacts with preformed antibody at the specific receptors on T and B cells. Antigens are the ligands that react with the products of an immune response

carcinogens - a substance that causes the initiation of tumor formation. Frequently a mutagen.

connective tissues - a primary tissue; form and function vary extensively. Functions include support, storage, and protection.

external secretions - assist in flushing microbes from the body. For example saliva, tears, perspiration, urine, and other body fluids

graft rejection - when immunologically competent graft is transported into an immunologically compromised host, the graft tissue can mount an immunologic attack on the recipient

histamine - a major vasoactive amine released from mast cell and basophil granules

HIV - Human Immunodeficiency virus

immunity (resistance) - the sum of all naturally occurring defense mechanisms that protect humans from infections disease

immunoglobulins - a group of serum molecules produced by B lymphocytes. Also known as antibodies

infection - growth of an organism within the body

lymphocytes - are central to all adaptive immune responses, since they specifically recognize individual pathogens, whether they are inside host cells or outside in the tissue fluids or blood. Two categories are T and B cells.

neoplasm (tumor) - a synonym for cancerous tissue

serotonin - increase vascular permeability and smooth muscle contraction. Originates from platelets

transformation - morphological changes in a lymphocyte associated with the onset of division. Also used to denote the change to the autonomously dividing state of a cancer cell

vaccine (vaccination) - material used to induce specific protective immunity to a pathogen. Vaccination is an artificial introduction of a killed or attenuated pathogen to promote protective immunity.

vascular supply - blood supply

vascular system - blood circulation system

viruses - obligate intracellular parasites that require the host cell's biochemical machinery to drive protein synthesis and metabolize sugars. Some produce acute infection and are eliminated from the host, whereas others persist indefinitely producing late disease.