Glossary

Abrasion: A scraping away of a portion of the surface of the cartilage to stimulate a repair response from the underlying bone.[i]

Aggrecan: A typical proteoglycan found in cartilage tissue.

Albumin secretion: Important function of hepatocytes in vivo and one of several surrogate markers for hepatocyte function in vitro. In vivo, albumin binds molecules and drugs in the blood and also contributes to the maintenance of plasma volume and blood osmotic pressure.

Alginate: A linear copolymer of β-D-mannuronic acid and α-L-guluronic acid that forms a 3-dimensional gel when exposed to divalent or trivalent cations. The gel can be used to entrap cells and can be dissolved with chelating agents, such as sodium citrate.

Alginate bead: A small ($\sim$10 μl) polymerized sphere of alginate gel, possibly containing cells, formed by dripping alginate solution into a bath containing divalent or trivalent cations, such as calcium chloride.

Alginate-recovered chondrocytes (ARC): Chondrocytes that are initially cultured in alginate gel under conditions that allow them to maintain normal phenotype and form a cell-associated matrix (CM) rich in aggrecan, and then recovered along with their CM by dissolution of the alginate gel with a chelating agent.

Alkaline phosphatase: A hydrolase enzyme, with an optimum pH of 8.6, distributed throughout the body, with concentrated forms in bone, liver, bile duct, and placenta. Elevated specific activity of the enzyme in cultures of mesenchymal stem cells treated with dexamethasone indicates osteogenic differentiation of the cells.

[i] *Stedman's Medical Dictionary, 27th edition © 2003 Lippincott Williams & Wilkins*

Culture of Cells for Tissue Engineering, edited by Gordana Vunjak-Novakovic and R. Ian Freshney

Allograft: A graft transplanted between genetically non-identical individuals of the same species.[i]

Antithrombogenic: Inhibitory to the formation of blood clots (thrombus, thrombosis); also: thrombo-resistant.

Arthroscopy: A special surgical instrument for visual examination of the interior of a joint.

Articular Cartilage: Cartilage that covers the articular surfaces of bones (i.e. at the joints).

Atherosclerosis: The disease process in which fats, cholesterol, and other substances are deposited in the lining of an artery causing the formation of a plaque which can compromise blood flow through the artery.

Autocrine: A mode of hormone or growth factor action in which a ligand binds to receptors on and affects the function of the cell type that produced it.

Autologous, autograft: Involving one individual as both donor and recipient.[ii]

BioArtificial Muscle (BAM): Tissue-engineered 3 dimensional muscle-like structures.

Biocompatibility: Compatibility with living tissue or a living system by not being toxic or injurious and not causing immunological rejection.

Bio-mimetic: Imitating a biological system.

Bioreactor: A device used for scaling up cultures, in this context for the three-dimensional culture of cells.

Burst/rupture strength: Of a blood vessel, the maximum intraluminal pressure that can be applied before rupture of the vascular wall.

Bypass, coronary artery: A surgical procedure in which blood flow is rerouted around a blockage in a coronary artery to restore blood flow to the heart.

Cardiac tissue engineering: Construction of heart tissue like structures including vessels, valves, and heart muscle.

Chondrocyte: A cartilage cell.

Chondrocytic: Of or pertaining to chondrocytes.

Chondrogenesis: The formation or development of cartilage.

Chondroprogenitor: A precursor cell that develops into a chondrocyte.

Collagen: A major protein found in the fibers of connective tissues.

Collagenase: Enzyme that cleaves peptide bonds in native collagen.

[ii] *Merriam-Webster Medical Dictionary, © 2002 Merriam-Webster, Inc.*

Confluency: When a surface is fully covered with a monolayer of cells, in which all cells are in contact with other cells all around their periphery.[iii]

Compliance: The ability of an elastic substance to yield to an applied force (the inverse of stiffness).

Cytochrome P450 enzymes: Family of enzymes that metabolize substrates such as toxins and drugs.

DAPI: (4′,6-Diamidino-2-phenylindole dihydrochloride)—Cell permeable fluorescent probe that binds to the minor groove of double-stranded DNA.

de novo: Anew.

Desmin: Protein found in intermediate filaments of muscle cells.

Dispase: Neutral protease used for cell dissociation.

Dexamethasone: A synthetic adrenocortical catabolic steroid. It is used to promote osteogenic differentiation in cultures of mesenchymal stem cells, possibly by inducing the cells to produce certain bone morphogenetic proteins.

Differentiation: The process cells undergo as they mature into normal cells. Differentiated cells have distinctive characteristics, perform specific functions and are less likely to divide.[iv] The opposite process, termed "de-differentiation" is commonly seen when chondrocytes are cultured in monolayer over several passages and they revert to a fibroblastic phenotype.

Endogenous: Originating or produced within the organism or one of its parts.

Engineered heart tissue: Artificial heart muscle constructed from heart cells, collagen, and extracellular basement membrane proteins.

ex vivo: Cultured in an artificial environment outside the living organism.

Extracellular matrix (ECM): Insoluble network of proteins and polysaccharides secreted by cells which can provide important structural support and regulatory signals to the cells. ECM consisting of laminin, collagen type IV, entactin, and several growth factors is commercially available for cell culture as an extract from mouse Engelbreth-Holm-Swarm tumors (Matrigel).

Fibrin: An insoluble protein derived from fibrinogen by the action of thrombin during blood clotting.[iv]

Fibroblastic: Resembling fibroblasts (i.e. spindle shaped).[iii]

Fibrocartilage: A kind of cartilage with a fibrous matrix (containing type I collagen fibers) that resembles fibrous connective tissue in structure.[i,iv]

[iii] *Freshney, RI. Culture of Animal Cells,* © 2005 *Wiley-Liss, Inc.*
[iv] *On-line Medical Dictionary, © 1997–98 Academic Medical Publishing & CancerWEB*

Gene transfer: Introduction of foreign DNA -"transgene"- into a cell. This can be mediated by recombinant adenovirus vectors and will in this case lead to transient expression of the transgene.

Glycosaminoglycan (GAG): Heteropolysaccharides which contain an n-acetylated hexosamine in a characteristic repeating disaccharide unit. The repeating structure of each disaccharide involves alternate 1,4- and 1,3-linkages consisting of either n-acetylglucosamine or n-acetylgalactosamine. GAG side chains (with the exception of hyaluronate) are covalently attached to a core protein at about every 12 amino acid residues to produce a proteoglycan, these proteoglycans are then non-covalently attached by link proteins to hyaluronate, forming an enormous hydrated space filling polymer found in extracellular matrix.[iv]

Graft: A material, especially a living tissue or an organ, surgically attached to or inserted into a bodily part to replace a damaged part or compensate for a defect.[i]

Growth factor: A factor (polypeptide hormone) that is involved in cell proliferation and differentiation.

Heart cells: A "physiological" mixture of cells from native hearts including cardiac myocytes and nonmyocytes (e.g. fibroblasts, endothelial cells, smooth muscle cells, pericytes, leukocytes).

Hematopoietic cell: A cell involved in the formation of blood.

Hepatocyte: Parenchymal cell of the liver responsible for numerous metabolic and synthetic functions.

Human growth hormone (hGH): Polypeptide hormone secreted by the anterior pituitary that promotes growth in humans, primarily by the release of somatomedin (insulin-like growth factor-1) from the liver.

Hydroxyproline: An amino acid ($C_5H_9NO_3$) produced during the hydrolysis of collagen.

Hyaluronan: A mucopolysaccharide made up of alternating ß1,4-linked residues of hyalobiuronic acid, forming a gelatinous material in the tissue spaces and acting as a lubricant and shock absorber.[i]

Integrin: Member of a large family of transmembrane protein receptors that are involved in cell-extracellular matrix (adhesion) and cell-cell interactions.

in vitro: Cultured outside the living body and in an artificial environment.

Isometric contraction experiment: Measurement of contractile properties at a defined preload.

Jamshidi needle: A long, tapered needle-drill combination used for obtaining bone core biopsies or bone marrow aspirates.

Liver zonation: The compartmentalization of specific functions to distinct zones along the liver sinusoid.

Mallory-Heidenhain: A histological stain that provides distinctive colors in fixed connective tissues and cells.

Matrix: A ground substance in which things are embedded or that fills a space (as for example the space within the mitochondrion). The most common usage is for a loose meshwork within which cells are embedded (e.g. extracellular matrix).[iv]

Metacarpophalangeal joint: Any of the spheroid joints between the heads of the metacarpal bones and the bases of the proximal phalanges.[i]

Mesenchymal: Derived from mesoderm or mesenchyme; mesenchymal tissue consists of undifferentiated cells loosely organized within an extracellular matrix in the embryonic mesoderm. Mesenchymal stem cells (MSCs) give rise to bone, cartilage, muscle, and other connective tissues. MSCs are undifferentiated cells within post-natal organisms that can, given the appropriate cues, differentiate along one or more of these mesenchymal lineage pathways.

Microfracture: The procedure of forming holes across the site of an articular defect, penetrating the subchondral bone marrow space to stimulate a repair reaction.[vi]

Micropatterning: Method of patterning extracellular matrix or cells on a substrate at the micron-scale.

Monolayer: A single layer of cells attached to a cell culture surface.

Multiplicity of infection (MOI): Number of infectious virus particles per cell. At an MOI of 1, all cells are infected.

Osteoblast: A bone-forming cell.

Osteocyte: A mature osteogenic cell that has become enclosed within a mineralized matrix elaborated by itself and other.

Osteochondral: Pertaining to bone and cartilage.[v]

Passage: Release of cells from monolayer, and subsequent replating. Typically, cells are passaged to expand the number of cells.

Perichondrium: The dense irregular fibrous membrane of connective tissue covering the surface of cartilage except at the endings of joints.[i]

Periosteum: The thick fibrous membrane covering the entire surface of a bone except its articular cartilage and serving as an attachment for muscles and tendons.[i]

Percoll: A proprietary suspension of colloidal silica coated with polyvinylpyrrolidone that is centrifuged to generate a density gradient capable of separating cells, viruses, or sub-cellular particles of different densities.

[v] *Dorland's Illustrated Medical Dictionary, 26th edition © 1981 W.B. Saunders*

Photolithograpy: The process used to transfer a pattern to a semiconductor wafer or other material. Photolithography typically utilizes the exposure of a light-sensitive photoresist through a mask.

Photoresist: A light-sensitive polymeric material. UV exposure causes a positive photoresist to become more sensitive to developer, thereby resulting in a photoresist pattern following development that is identical to the mask pattern. In contrast, UV exposure causes a negative photoresist to become less sensitive to developer.

Polyglycolic acid (PGA): A biodegradable polymer, with high melting point and low solubility in organic solvents. Used for biomaterial applications, including sutures and tissue engineering scaffolds.[vi]

Polylactic acid (PLA): A polymer used in biomaterial applications which is more hydrophobic and also has a slower degradation rate than polyglycolic acid.[vi]

Progenitor cells: Cells found in all tissues, and are responsible for the growth and regeneration of those tissues throughout the life of the organism.

Proliferation: The reproduction or multiplication of cells.

Proteoglycan: A high molecular weight complex of protein and polysaccharide, characteristic of structural tissues of vertebrates, such as bone and cartilage, but also present on cell surfaces. Important in determining viscoelastic properties of joints and other structures subject to mechanical deformation.[iv]

Recombinant proteins: Proteins expressed in host cells infected with cloned DNA fragments.

Resting tension: Tension at zero active force generally expressed in mN.

Scaffold: A structure made of natural or synthetic biomaterials, which provides shape and mechanical support for regeneration of a tissue from cells.

Sericin: A gelatinous protein that cements the two-fibroin filaments in a silk fiber.

Shear stress: In blood vessels, friction occurring between blood elements and the vessel wall.

Skeletal myoblasts: Precursor muscle cells capable of forming myocytes which fuse with either existing muscle fibers, or with other myocytes to form muscle fibers.

Spongialization: The complete removal of the subchondral bone plate at the lesion site, to expose the cancellous bone or spongiosa, and induce bleeding and repair response.[vii]

Stem cells: Undifferentiated cells that have the capacity to divide asymmetrically, thus generating both new stem cells and differentiated progeny.

[vi] *Ratner, BD et. al. Biomaterials Science © 1996 Academic Press*
[vii] *Hunziker, EB. " Articular cartilage repair." Osteoarthritis and Cartilage (2001) 10, 432–463.*

Strain: Expression of deformation caused by stress on an object; **cyclic strain** refers to deformation of the vascular wall caused by repeated cycles of increased blood pressure due to contraction of the heart.

Subchondral: Beneath or below the cartilage layer.

Superficial zone protein (SZP): A large glycoprotein product of the proteoglycan 4 (PRG4) gene that is secreted by the cells of the superficial zone of articular cartilage and provides lubrication at the articular surface. SZP is homologous to a molecule purified from synovial fluid, named lubricin.

Supernatant: Clear liquid overlying material deposited by centrifugation.

Suture retention strength: Maximum force that can be applied to a suture before it pulls out of the substance into which it has been placed.

Synovial fluid: A clear viscous fluid which serves as a lubricant in joints. It also helps to nourish the avascular articular cartilage.

Target validation: Identification of the role of certain proteins -"targets"- in physiologic and/or pathologic conditions. These findings might facilitate the development of new treatment strategies.

Tensile strength: The maximum amount of tensile stress (tension) that can be applied to a material before it breaks.

Tisseel: Fibrin sealant from plasma; main component is fibrinogen.

Tissue replacement therapy: Surgical replacement of diseased tissue with in vitro constructed tissue equivalents.

Transcript: A sequence of RNA produced by transcription from a DNA template.

Transduction: Process by which heritable DNA is stably transferred into the genome of dividing cells.

Tropomyosin: Contractile protein located in skeletal muscle.

Twitch tension: Contraction amplitude of a muscle generally expressed in millinewton (mN; 1 Newton $=$ 1 kg $\times$ m/s^2). Used as a measure of active contractile force.

Ultimate tensile strength: The maximum resistance to fracture.

Vastus lateralis: Division of the quadriceps muscle that covers the outer anterior aspect of the femur.

VEGF: Vascular endothelial growth factor—proliferation growth factor that stimulates new blood vessel formation by triggering proliferation of vascular endothelial cells.

Vasoactive substances: Molecules which act up the cells of blood vessels to cause vascular dilation or constriction.

Yield point: The yield stress extrapolated to a shear rate of zero.

Zyderm: FDA approved, highly purified bovine dermal collagen.