

**Supplementary Table S3**

A tabulation of cell types and their role within pFTUs, together with a corresponding set of contiguous sFTUs, for 12 mammalian organ systems.

Organ	Secondary FTU	Primary FTU	
		Cell types	Cell functions
<b>CARDIOVASCULAR SYSTEM</b>			
Vascular system	Blood(B) (1 mL volume)	erythrocyte reticulocyte monocyte lymphocyte basophil eosinophil neutrophil platelet macrophage (MP)	bind O <sub>2</sub> immature RBC innate response to pathogens, inflammatory response T cell, B cell, NK cell (see immune cells) s. heparine & histamine, <0.3% WBCs combat multicellular parasites, 1-6% of WBCs phagocyte, 40-75% of WBCs thrombus formation, s. growth factors engulf foreign material
	Capillaries	endothelial cell (EC) pericyte (PC) B	transport, barrier contractile cells that wrap around capillary & venule ECs
	Arteries	smooth muscle cell (SMC) fibroblast (FB) B, EC	contraction s. collagen
	Veins	B, EC, SMC, FB, PC	
Heart (Left ventricle Right ventricle Left atrium Right atrium)	Muscle bundle	cardiomyocyte	contraction, action potential action potential
	Bundle of His Purkinje network	Purkinje cell	
	Mitral valve Aortic valve	SMC	
	Muscle bundle	cardiomyocyte	
	Purkinje network	Purkinje cell	
	Tricuspid valve Pulmonary valve	SMC	
	Muscle bundle	cardiomyocyte	
	Muscle bundle Sino-atrial node	SAN cell B, EC, SMC, FB, PC	action potential
Muscle bundle Atrio-ventricular node	AVN cell B, EC, SMC, FB, PC	action potential	
<b>RESPIRATORY SYSTEM (all pFTUs include B, EC, SMC, FB, PC, MP)</b>			
Nasal cavities	Olfactory epithelium	olfactory receptor neuron sustentacular cell basal cell	express olfactory (GPCR) receptors provides structural support, glia-like, s. mucous source of new receptor cells
Pharynx	Epithelial conduit	epithelia cell	barrier

Larynx	Epithelial conduit	epithelia cell small granule cell	barrier
Lung (Trachea & bronchi Bronchioles & acinii)	Bronchi (non-respiratory airways)	epithelia cell goblet cell basal cell	Barrier s. mucin
	Alveolus (respiratory airways)	type 1 alveolar cell type 2 alveolar cell Clara cell	50nm barrier permeable to O <sub>2</sub> /CO <sub>2</sub> exchange. 97% surface. s. surfactant s. glycosaminoglycans
<b>MUSCULO-SKELETAL SYSTEM</b> (all pFTUs include B, EC, SMC, FB, PC, MP)			
Compact bone Cancellous bone Membranous bone	Osteon	osteoblast osteocyte osteoclast	orchestrate mineralisation of bone, s. dense, crosslinked collagen osteoblast embedded within the bone matrix, s. sclerostin dissolves bone
Muscle (Fast fibres Slow fibres)	Motor unit	muscle fibre satellite cell	contract quiescent mononucleated myogenic cells
	Motor end plate	neuron muscle fibre	activation of muscle fibre contraction
	Muscle spindle	type Ia sensory fiber type II sensory fiber alpha motor neuron gamma motor neuron beta motor neuron intrafusal muscle fibre extrafusal muscle fiber	
	Golgi tendon organ	Neuron	
Tendon	Fascicle	tenocyte perifibrotenocyte	elongated fibroblast (needs tension to maintain cell type)
Ligament	White ligament Yellow ligament Bursa	fibrocyte	inactive mesenchymal cell
Articular Cartilage	Chondron	chondroblast chondrocyte chondroclast	forms chondrocytes (originates in MSC) s. cartilage matrix & is embedded in it removes chondroblasts
	Synovial fluid	factors that maintain cartilage	
<b>DIGESTIVE SYSTEM</b> (all pFTUs include B, EC, SMC, FB, PC, MP)			
Mouth Oral cavity	Taste bud	taste receptor cell support cell basal cell	receptors for salty, sour, bitter, sweet & umami glia-like, s. mucous source of new receptor cells

Salivary glands	Parotid gland	mucous cell serous cell intercalated duct cell striated duct cell	s. mucous  s. $\alpha$ -amylase (carbohydrate digestion)
	Submandibular gland	mucous cell serous cell	produce 60-67% of the total volume of saliva
	Sublingual gland	mucous cell serous cell	major salivary glands in the mouth
Tongue	Glands		s. lipase (fat digestion)
Tooth		ameloblast odontoblast	s. tooth enamel s. dentin
Nose			
Oesophagus	Epithelial conduit	epithelial cell	peristaltic wave
Stomach	Antrum	G cells	s. gastrin
	Gastric gland	surface mucous cell mucous neck cell parietal cell principal (chief) cell	s. HCL, intrinsic factor s. pepsinogens
Small intestine (Duodenum Jejunum Ilium)	Gastric gland Crypt of Lieberkuhn Brunner's gland	surface mucous cells mucous neck cells parietal cells enteroendocrine D cell enteroendocrine ECL cell principal (chief) cell enterochromaffin cell	s. $\text{HCO}_3^-$ , mucus s. mucus s. HCL, intrinsic factor s. somatostatin s. histamine, gastrin, secretin, CCK s. pepsinogens s. 5-HT
	Villus	Goblet cell epithelial cell	s. mucus
Large intestine	Crypt	Paneth cell	immunological function
	Villus	Goblet cell enteroendocrine cell	s. mucus s. hormones
Colon (Secum, Anus)	Crypt	epithelial cell endocrine cell	s. peptide YY
Liver	Liver lobule	hepatocyte  Kupffer cell stellate cell B, EC, FB	detoxification, modification, and excretion of exogenous and endogenous substances s. cholesterol, bile salts and phospholipids carbohydrate metabolism, protein synthesis & storage specialised macrophages in space of Disse precursor hepatocyte or FB? Role in immune reaction.
Gall bladder		epithelial cell	
Exocrine pancreas	Intra- & inter-lobular ducts	epithelial cell centroacinar cell pancreatic acinar cell	s. $\text{HCO}_3^-$ , protease precursors, lipase, s. $\alpha$ -amylase, collagenase, elastase, ribonuclease s. $\alpha$ -amylase, collagenase, elastase, ribonuclease

<b>URINARY SYSTEM</b> (all pFTUs include B, EC, SMC, FB, PC, MP)			
Kidney	Nephron (Bowman's capsule Glomerulus Proximal tubule Loop of Henle Distal tubule Collecting duct)	mesangial cell podocyte	specialized SMC wrap around capillaries of glomerulus
		juxtaglomerular cell proximal tubule cell thin segment epithelial cell principal cell of collecting duct intercalated cell	s. renin (specialised SMC) Na <sup>+</sup> & H <sub>2</sub> O uptake; H <sup>+</sup> / HCO <sub>3</sub> <sup>-</sup> exchange; s. organic acids descending limb of Henle highly permeable to H <sub>2</sub> O ascending limb of Henle impermeable to H <sub>2</sub> O control Na <sup>+</sup> & H <sub>2</sub> O uptake in response to aldosterone and vasopressin acid-base homeostasis
Urinary bladder	Epithelial conduit	epithelial cell	barrier
Ureter	Epithelial conduit	epithelial cell	barrier
Urethra	Epithelial conduit	epithelial cell	barrier
<b>ENDOCRINE SYSTEM</b> (all pFTUs include B, EC, SMC, FB, PC, MP)			
Pituitary gland	Adeno-hypophysis	somatotrope (GH cell) lactotrope (PRL cell) corticotrope (ACTH cell) gonadotrope (FSH & LH cells) thyrotrope (TSH cell)	s. growth hormone (GH) s. prolactin (PRL) (s. milk production, gonadal function) s. ACTH (s. cortisol secretion from adrenal cortex) s. FSH & LH (control gonadal function) s. TSH (s. release of thyroxine from thyroid gland)
	Neuro-hypophysis		
Thyroid gland	Thyroid gland	follicular epithelial cell parafollicular cell	s. thyroid hormones (thyroxine & triiodothyronine) s. calcitonin
Parathyroid glands	Parathyroid gland	principal cell oxyphil cell	s. parathyroid hormone s. parathyroid hormone-related protein (PTHrP) & calcitriol
Adrenal gland	Adrenal medulla	chromaffin cell	s. catecholamines (neuroendocrine cells)
	Adrenal cortex	adrenocortical cells	s. aldosterone and cortisol
Endocrine pancreas	Islet of Langerhan	α cell β cell δ cell	s. glucagon s. insulin s. somatostatin
Pineal gland	Pineal gland	pinealocyte	s. melatonin
<b>IMMUNE SYSTEM</b> (all pFTUs include B, EC, SMC, FB, PC, MP)			
Bone marrow		haemopoietic cell mesenchymal cell osteoprogenitor cell	pluripotent cell that generates blood cells multipotent stromal cell (SMC) → osteoblast, chondrocyte, adipocyte mesenchymal cell that differentiates into an osteoblast
Spleen	Red pulp White pulp		
Thymus	Thymus	thymocyte Hassal's corpuscle epi. cell	generate T cells s. cytokine TSLP
Lymph node	Lymph node	B cell helper-T cell cytotoxic-T cell NK cell	s. antibodies CD4+ T cell, s. lymphokines to activate B cells & killer T cells CD8+ T cell, active against virus infected & cancer cells cytotoxic lymphocyte (innate immune system)
<b>NERVOUS SYSTEM</b> (all pFTUs include B, EC, SMC, FB, PC, MP)			
Forebrain   elencephalon	Cortical column	neuron astrocyte or glial cell	conduct action potential control environment around synapses

Cerebral cortex		microglia oligodendrocyte	s. CSF; line the CSF-filled ventricles (type of glial cell) macrophages of brain insulate neurons (type of neuroglia)
Ventricles		ependymal cell	
Limbic system	Cingulate gyrus		
	Hippocampus		
	Septum		
	Amygdala		
Basal ganglia	Caudate nucleus		
	Putamen	cholinergic interneuron GABA/parvalbumin interneuron SOM/NOS interneuron	s. acetylcholine s. GABA & parvalbumin s. somatostatin (SOM) & nitric oxide synthase (NOS)
	Globus pallidus		
	Subthalamic nucleus		
Forebrain Diencephalon	<u>Subregions that modulate</u> Motor Behaviour Mood Auditory Limbic ...		
Thalamus			
Hypothalamus	Supraoptic nuclei		s. vasopressin
	Paraventricular nuclei		s. oxytocin
<u>Brain stem</u> Midbrain (Mesencephalon)	Substantia nigra Superior colliculus Inferior colliculus		
	Pons		
	Inferior olive		
	Red nucleus		
Hindbrain (Rhombencephalon)	Medulla		
	Cerebellum	basket cell Golgi cell granule cell Purkinje cell	inhibitory GABA-ergic interneuron inhibitory GABA-ergic interneuron (granule cell layer) afferent neuron GABA-ergic output neuron
Reticular formation	HR control Respiratory control ...		
	Olfactory (1) Optic (2) Eye muscles (3,4,6) Sensory face (5) Motor face (7) Vestibular system (8) Cochlea (8) Gut autonomic (9,10) Neck muscles (11) Tongue (12)		
Cranial nuclei			

Spinal chord	<i>Dorsal horn</i> (skin sensory) <i>Intermediate horn</i> (autonomic sensory & motor) <i>Ventral horn</i> (motor control)	Neuron Interneuron Oligodendritic cell Microglia Astrocyte Schwann cell	
<b>INTEGUMENTARY SYSTEM</b> (all pFTUs include B, EC, SMC, FB, PC, MP)			
Skin	Epidermis	keratinocyte stratum germinativum cell stratum spinosum cell stratum granulosum cell stratum corneum cell melanocyte Langerhans cell Merkel cell	s. keratin, barrier basal layer s. keratin, desmosomal connections to adjacent cells s. keratohyalin granules outer layer, dead cells s. melanin dendritic APC of skin synaptic contacts with somatosensory afferents
	Eccrine sweat gland	myoepithelial cell apocrine sweat gland cell sebaceous gland cell mucous epithelial cell mesothelial cell synovial cell	contract to aid secretion
	Apocrine sweat gland	myoepithelial cell	contract to aid secretion
<b>FEMALE REPRODUCTIVE SYSTEM</b> (all pFTUs include B, EC, SMC, FB, PC, MP)			
Ovaries	Ovary	oocyte theca interna cell lutein cell	give rise to egg by meiosis express receptors for luteinizing hormone (LH) s. progesterone and estrogen
Fallopian tubes	Epithelial conduit	secretory cell ciliated cell	
Uterus	Epithelial conduit	endometrial epithelial cell endometrial granulocyte decidual cell	
Placenta		cytotrophoblast Hofbauer cell EC, SMC, FB, PC, MP	cover the entire surface of the villous tree macrophage; s. VEGF & other proangiogenic factors
Vagina	Epithelial conduit	epithelia cell	
External genitalia			
Breasts	Mammary gland	alveolar myoepithelial cell mammary gland cell	contract under the stimulation of oxytocin s. milk
<b>MALE REPRODUCTIVE SYSTEM</b> (all pFTUs include B, EC, SMC, FB, PC, MP)			
Testis		spermatocyte spermatid spermatozoon	diploid cell that undergoes meiosis to form four spermatids haploid male germ cell that has completed meiosis mature motile sperm cell
Ductuli efferentes			

Seminal vesicle	Epithelial conduit		
Penis	Epithelial conduit		
<b>SPECIAL SENSES (all pFTUs include B, EC, SMC, FB, PC, MP)</b>			
Eye	Sclera	lacrimal gland cell	
	Retina	rod cell cone cell Muller cell amacrine cell bipolar cell retina ganglion cell pigment epithelial cell ciliary epithelial cell	photoreceptor used in peripheral field (low light vision) photoreceptor used in fovea centralis (colour vision) retinal glial cells interneurons for photoreceptors to ganglion cells (70%) interneurons for photoreceptors to ganglion cells (30%) retinal neurons precursor retinal cells
	Lens	epithelial cell	
	Cornea	epithelial cell	
Ear	Outer ear		
	Middle ear Ceruminous glands		s. wax
	Cochlea Organ of corti	inner hair cell outer hair cell supporting cell	mechano-sensory cell contractile cell that changes stiffness of tectorial membrane to sharpen frequency discrimination structural
Vestibular function	Vestibular labyrinth	hair cell type I & II supporting cell dark cell of crista ampullaris	mechano-sensory cell structural role in fluid transport