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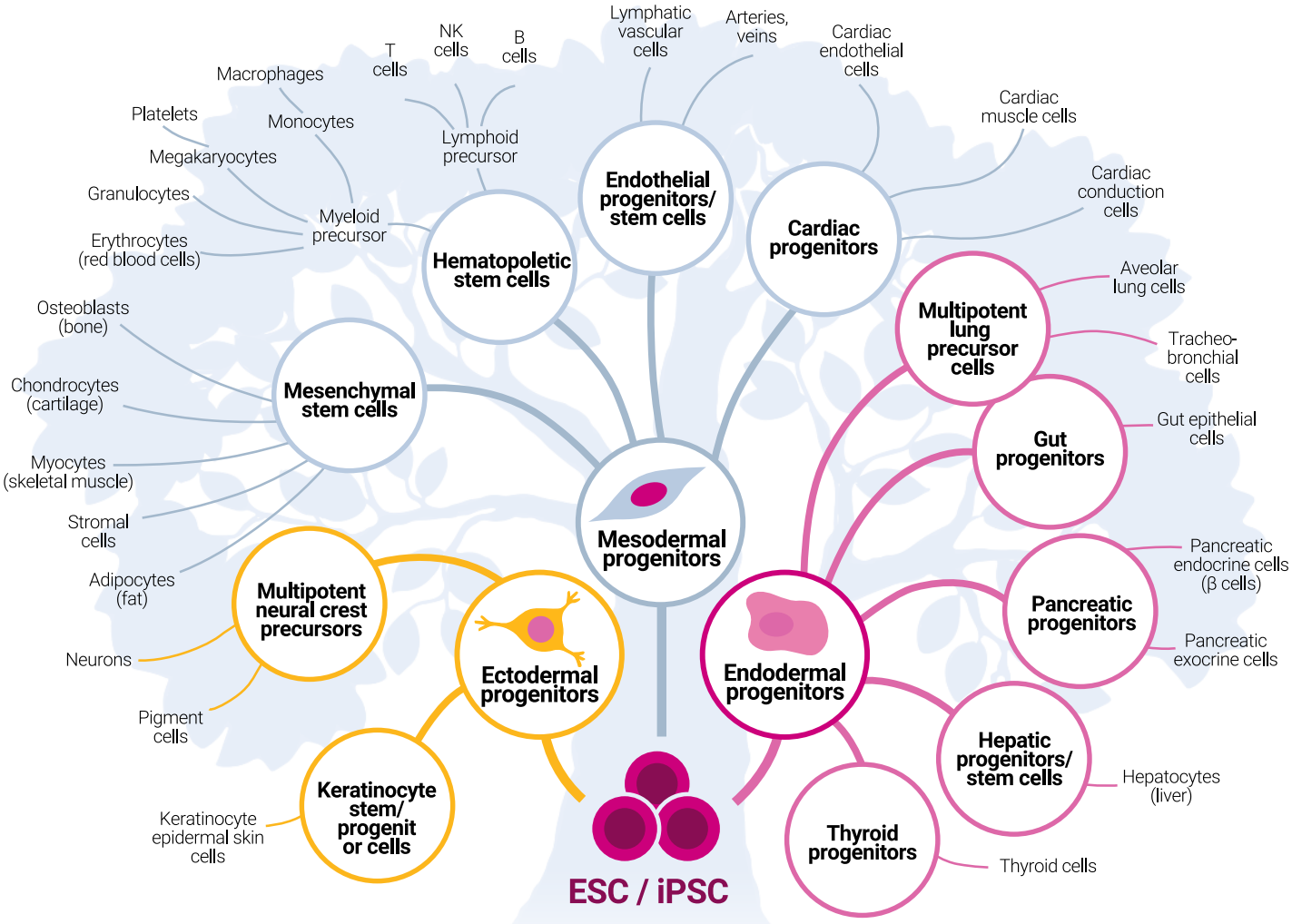
biogems
A PeproTech Brand

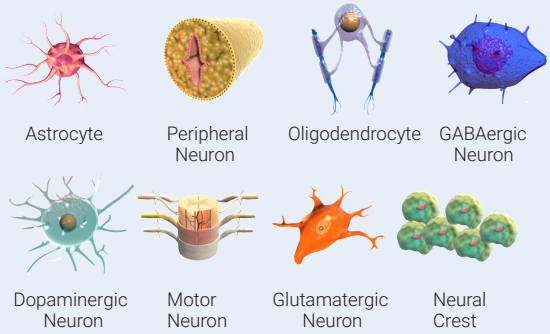
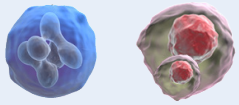
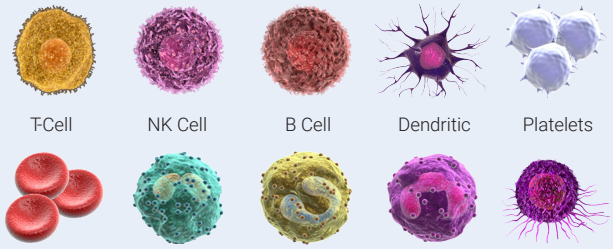
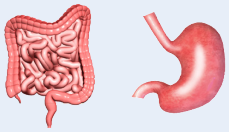
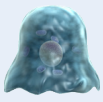
Differentiation of Embryonic and Induced Pluripotent Stem Cells

Pluripotent stem cells possess the capacity for indefinite self-renewal and the potential to differentiation into all adult cell types of the three primary germ layers. These features nominate pluripotent stem cells as a major component in the field of regenerative medicine due to their superior candidacy for the replacement of lost, damaged or diseased cells.

While embryonic stem cells (ESCs) are the most well-known type of pluripotent stem cell, the generation of ESCs from human embryos has resulted in a great deal of controversy. The introduction of induced pluripotent stem cells (iPSCs), has been a major breakthrough in the field of regenerative medicine as it allows for the generation of pluripotent stem cells directly from adult cells. This method circumvents the controversial use of human embryos, while also minimizing the risk of immune rejection as iPSCs generated from adult cells can offer an unlimited supply of autologous cells.

The use of ESCs and iPSCs in cell therapies and research does not only require their procurement, but also their *in vitro* differentiation into fully-functioning, specialized cell types. Differentiation can be influenced and controlled through exposure to specific chemical and physical signals. Common chemical signals can include the use of cytokines, growth factors, and small molecules, to either activate or inhibit specific cellular pathways to achieve a desired cell fate.



Pathway	PeproTech Cytokines and Growth Factors	BioGems Small Molecules	Cell Type
Self Renewal	FGF-basic TGF-β1	CHIR 99021 PD 0325901 Thiazovivin Y-27632 Dihydrochloride	 Embryonic stem sells (ESC)/ induced pluripotent stem cells (iPSC)
Neurogenesis	BDNF CTNF EGF FGF-8a, b FGF-basic GDNF IGF I β-NGF Noggin NT3,-4 PDGF-AA, -AB, -BB, -CC Sonic Hedgehog (shh)	9-cis-Retinoic Acid All-Trans Retinoic Acid Dorsomorphin LDN 193189 Hydrochloride SB 431542	 Astrocyte, Peripheral Neuron, Oligodendrocyte, GABAergic Neuron, Dopaminergic Neuron, Motor Neuron, Glutamatergic Neuron, Neural Crest
Adipogenesis	BMP-2, -4, -7 FGF-basic TGF-β_1	5-Azacytidine Dexamethasone IBMX L-Ascorbic Acid	 White Adipocytes, Brown Adipocytes
Hematopoiesis	BMP-4 EPO IL-2, -3, -4, -6, -7, -11, -15 Flt3-Ligand G-CSF GM-CSF SCF TPO $VEGF_{165, 121}$		 T-Cell, NK Cell, B Cell, Dendritic, Platelets, Erythrocytes, Eosinophils, Basophils, Neutrophils, Macrophage
Gastrointestinal	Activin-A EGF FGF-4, -10 Noggin R-Spondin-1 Wnt-3a	A 83-01 CHIR 99021 Gastrin I IWP-2 LY2157299 Nicotinamide SB 202190 Y-27632 Dihydrichloride	 Intestinal Tissue, Stomach Tissue
Cardiomyogenesis	Activin-A BMP-4 DKK-1 FGF-4, -8 FGF-basic VEGF-A	CHIR 99021 Dorsomorphin endo-IWR-1 IWP 2 SB 431542	 Cardiac Muscles, Cardiomyocytes
Osteogenesis	BMP-2, -4, -6 FGF-basic IGF-1 IL-1, -6, -7, -11, -15 LIF M-CSF PTHrP sRANK Ligand SDF-1α (CXCL12) SDF-1β (CXCL12) TGF-β_1	9-cis-Retinoic Acid All-Trans Retinoic Acid Dexamethasone L-Ascorbic Acid	 Mature Osteoblast/ Osteocytes (Bone)

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