PEPROTECH
Part of Thermo Fisher Scientific

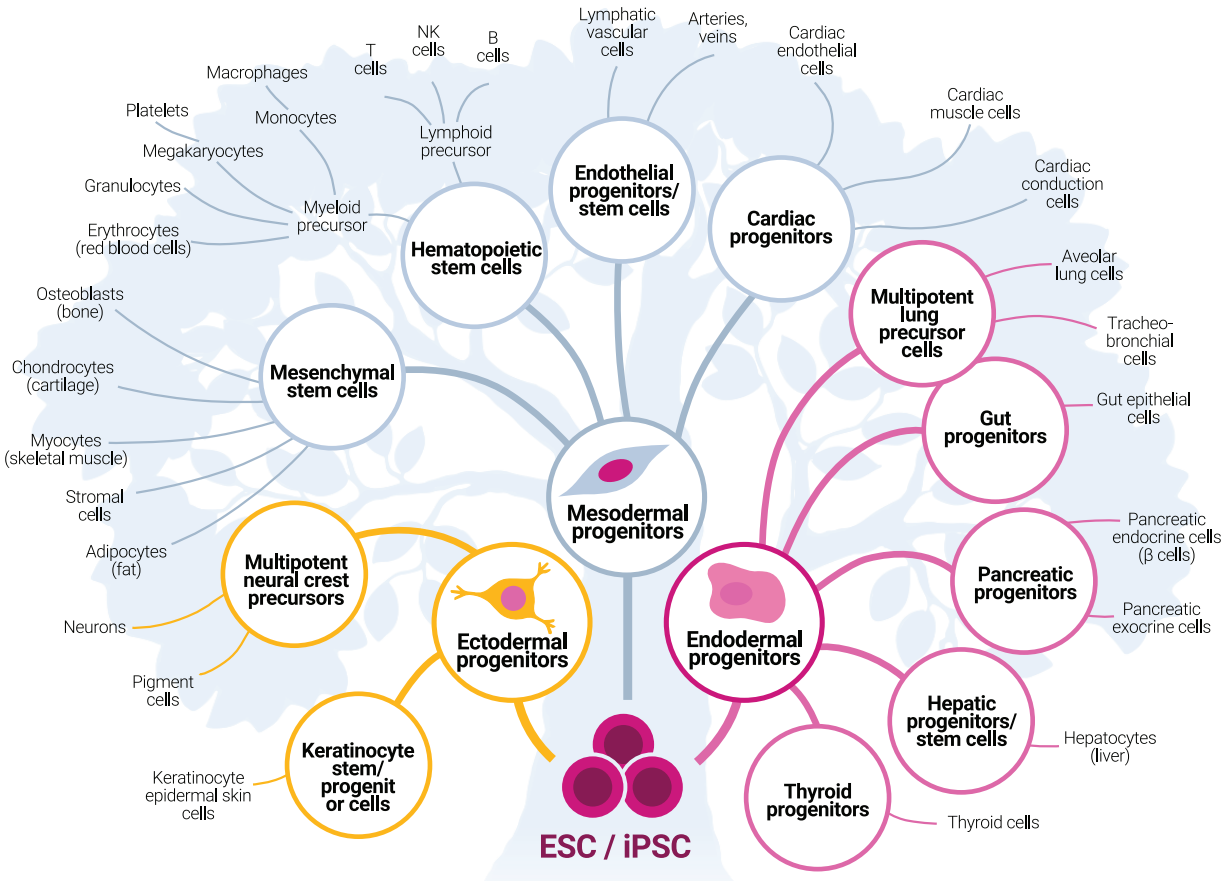
PeproTech products are now part of the gibco by Thermo Fisher Scientific Recombinant Protein Portfolio

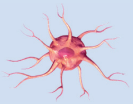
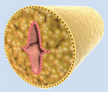
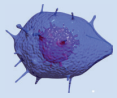
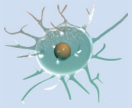
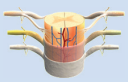
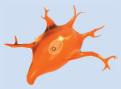
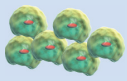
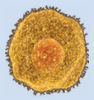
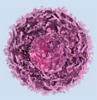
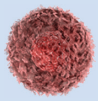
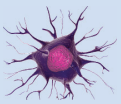
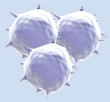
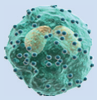
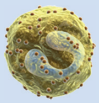
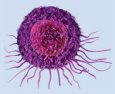
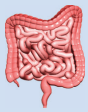
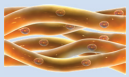
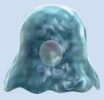
Differentiation of embryonic and induced pluripotent stem cells

Pluripotent stem cells possess the capacity for indefinite self-renewal and the potential to differentiate into all adult cell types of the three primary germ layers. These features make pluripotent stem cells important candidates in the field of regenerative medicine due to their exceptional potential for 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. Since iPSCs generated from adult cells can offer an unlimited supply of autologous cells, this circumvents the controversial use of human embryos while helping to minimize the risk of immune rejection.

The use of ESCs and iPSCs in cell therapies and research requires not only 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 include 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	Cell type
Self-renewal	FGF-basic TGF-β1	 Embryonic stem cells (ESCs), induced pluripotent stem cells (iPSCs)
Neurogenesis	BDNF CNTF EGF FGF-8a, b FGF-basic GDNF IGF-I β-NGF Noggin NT-3, -4 PDGF-AA, -AB, -BB, -CC Sonic hedgehog (Shh)	 Astrocytes  Peripheral neurons  Oligodendrocytes  GABAergic neurons  Dopaminergic neurons  Motor neurons  Glutamatergic neurons  Neural crest
Adipogenesis	BMP-2, -4, -7 FGF-basic TGF-β1	 White adipocytes  Brown adipocytes
Hematopoiesis	BMP-4 EPO IL-2, -3, -4, -6, -7, -11, -15 Flt3-ligand G-CSF GM-CSF SCF TPO $VEGF_{165,}$ $VEGF_{121}$	 T cells  NK cells  B cells  Dendritic cells  Platelets  Erythrocytes  Eosinophils  Basophils  Neutrophils  Macrophages
Gastrointestinal	Activin A EGF FGF-4, -10 Noggin R-spondin-1 Wnt-3a	 Intestinal tissue  Stomach tissue
Cardiomyogenesis	Activin A BMP-4 DKK-1 FGF-4 FGF-8a, b FGF-basic $VEGF_{165, 121}$	 Cardiac muscle  Cardiomyocytes
Osteogenesis	BMP-2, -4, -6 FGF-basic IGF-I IL-1α, -1β, -6, -7, -11, -15 LIF M-CSF PTHrP sRANK ligand SDF-1α (CXCL12) SDF-1β (CXCL12) TGF-β1	 Mature osteoblasts, osteocytes (bone)

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