PEPROTECH®
Part of **Thermo Fisher Scientific**

PeproTech products are now part of the

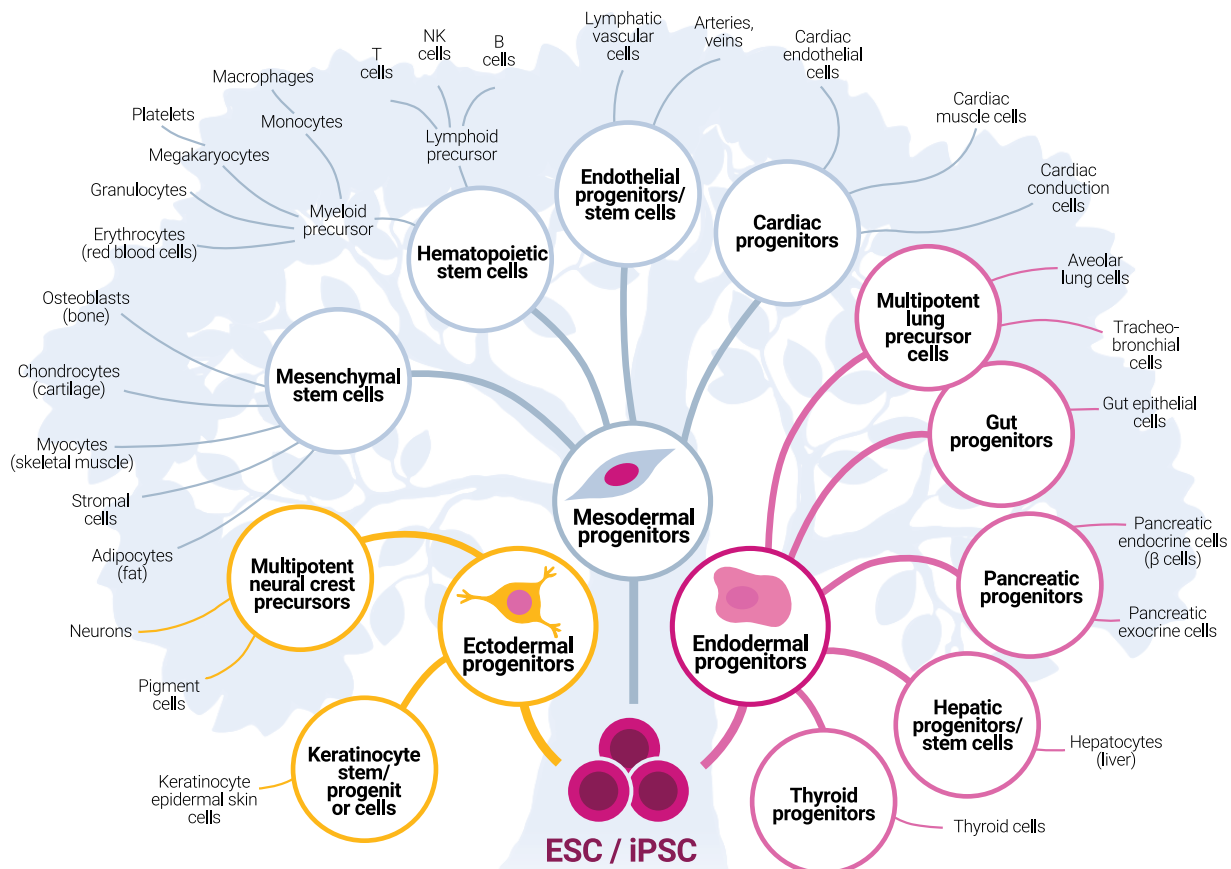**gibco**
by **Thermo Fisher Scientific**

Recombinant Protein Portfolio

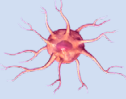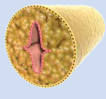# Differentiation of embryonic and induced pluripotent stem cells
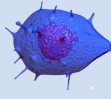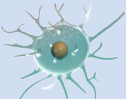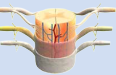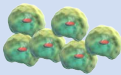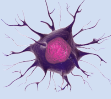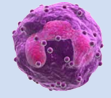
Pluripotent stem cells possess the capacity for indefinite self-renewal and the potential to differentiate into all adult cell types of the three primary germ layers. These features make pluripotent stem cells important candidates in the field of regenerative medicine due to their exceptional potential 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 Dopaminergic neurons	Peripheral neurons Motor neurons	Oligodendrocytes Glutamatergic neurons	GABAergic 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 Erythrocytes	NK cells Eosinophils	B cells Basophils	Dendritic cells Neutrophils	Platelets 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)				

Learn more at **thermofisher.com/peprotech**