

Human Hematopoietic Stem and Progenitor Cell Phenotypes, Frequencies and Hierarchies

+	Expressed on all cells
lo	Lowly expressed on all or most cells
-	Not expressed (or not detectable) on all or most cells
+/-	Heterogeneously expressed in cell population
	Not known / Not applicable

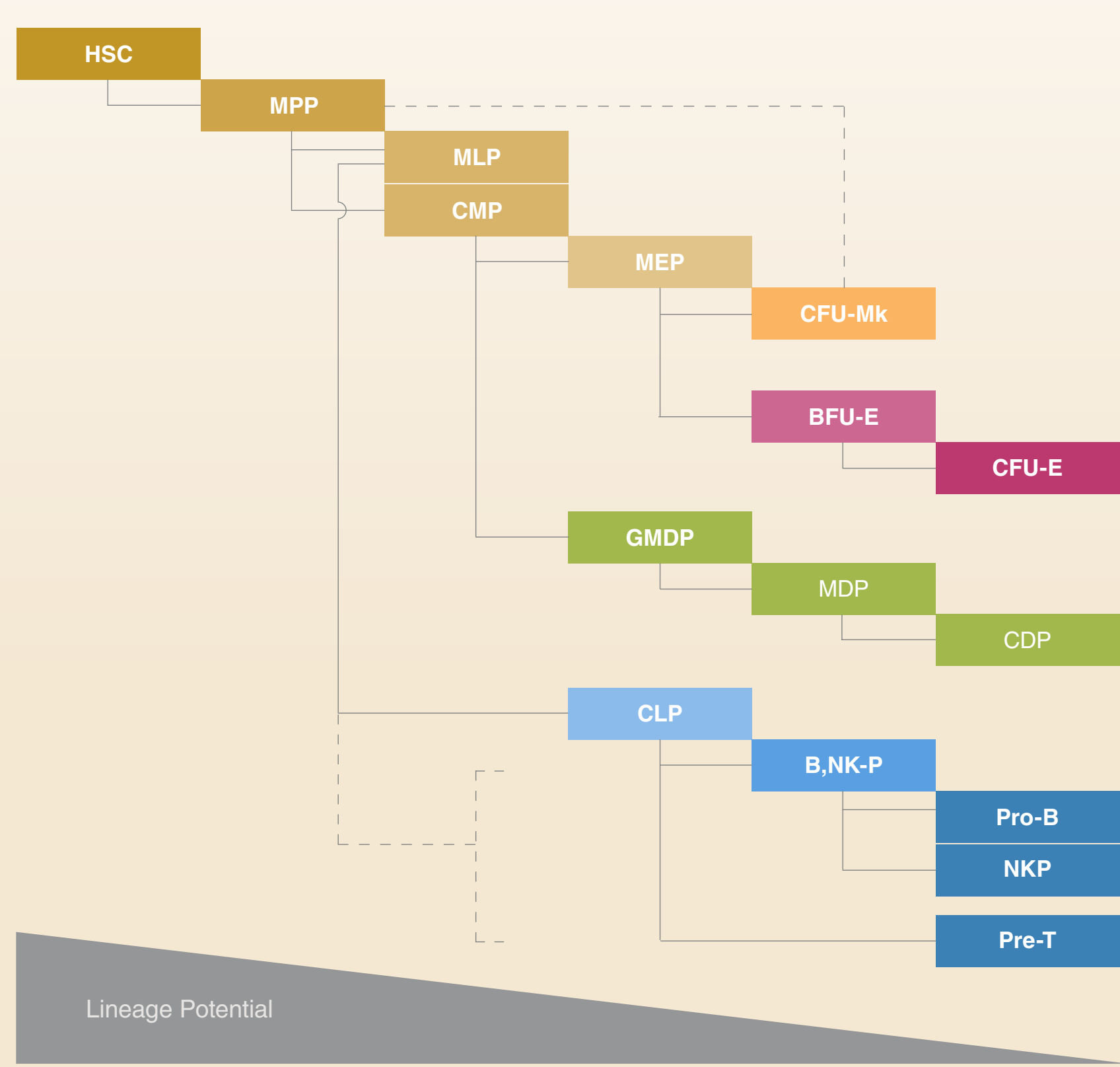
Stem/Progenitor Cell	Properties	Lineage Potential	Approx. Freq. in CB*		HSPC Identifiers					Erythroid, Mk Identifiers					Cytokine Receptors							Lymphoid Identifiers																	
			% of MNCs	% of CD34+	Lineage*	CD34	CD38	CD45RA	CD90	CD49f	CD71	CD105	CD36	CD235 (GlyA)	CD41	CD117 (c-Kit)	CD135 (FLT3)	CD110 (Mpl)	CD123 (IL-3Rα)	CD115 (M-CSFR)	CD116 (GM-CSFRα)	CD127 (IL-7Rα)	CD7	CD10	CD5	CD24	CD19	CD1a	CD2	icCD3e									
Hematopoietic Stem Cell (HSC) ^{16,17}	* 10% of population have NSG mouse repopulating ability at 20 weeks ¹⁶ * Maintains steady state hematopoiesis in humans after transplantation ¹	All	0.04	1.5	-	+	-	-	+	+	-	-			+	+	+	lo	-	-																			
Multipotent Progenitor (MPP) ^{6,12}	* Most have short-term repopulation ability (2 - 10 wks) in NSG mice and 0.1% have long-term NSG repopulation ability ¹⁶ * Significantly contributes to long-term steady state hematopoiesis in humans after transplantation ¹	All	0.04	2.5	-	+	-	-	-	-	-	-			+	+	+	+	-	-																			
Multilymphoid Progenitor (MLP) ^{4,8}	Gives rise to all lymphoid cell types as well as some myeloid cell types	Lymphoid, Monocytic, Macrophage, Dendritic	0.02	1 - 2	-	+	-	+	lo							+																							
Common Myeloid Progenitor (CMP) ^{4,13,14}	* Develops from MPPs to produce all myeloid lineages * Large portion of population is primed or committed to specific lineage	Myeloid, Erythroid, Megakaryocytic	0.15 - 0.4	24.5	-	+	+	-			-	-			+/-	+	+/-		+																				
Megakaryocyte-Erythroid Progenitor (MEP) ^{3,4,8,13,14,20}	Arises from CMPs, produces erythroid and megakaryocytic cells	Erythroid, Megakaryocytic	0.05 - 0.3	8.0	-	+	lo	-			+/-			+/-	+	-	+	-																					
Megakaryocyte Progenitor (CFU-Mk) ^{4,20}	Originates from MEPs, or directly from HSCs and MPPs ¹⁷	Megakaryocytic			-	+	-	-			+	-		-	+	-	+	-																					
Erythroid Progenitor (BFU-E) ^{11,14,20}	Represents a primitive erythroid progenitor	Erythroid	0.1 - 0.35		-	+	+	-			lo	+	-	-	-	+	-	-																					
Erythroid Progenitor (CFU-E) ¹¹	* Represents a late erythroid progenitor * Frequency is over 10-fold higher in BM than in CB or PB ¹¹	Erythroid	0.004 - 0.05		-	-					+	+	+	-	-	+																							
Granulocyte-Monocyte-DC Progenitor (GMDP) ^{6,10,13}	* Also known as "Granulocyte-Macrophage Progenitor (GMP)" * Gives rise to the most immature CFU-GM, CFU-G, CFU-M and dendritic cell (DC) progenitors ¹⁰	Granulocytic, Monocytic, Dendritic (pDC, cDC)	0.05 - 0.3	10	-	+	+	+							+	+		+	-	lo																			
Monocyte-DC Progenitor (MDP) ¹⁰	* More restricted lineage potential than GMDP * Gives rise to CFU-M and DC, but not CFU-G progenitors ¹⁰	Monocytic, Dendritic (pDC, cDC)		0.6	-	+	+	+							+	+		+	+	lo																			
Common Dendritic Cell Progenitor (CDP) ¹⁰	* More restricted lineage potential than MDPs * Gives rise to plasmacytoid and conventional DCs	Dendritic (pDC, cDC)		0.4	-	+	+	+							+	+		+	-	lo																			
Common Lymphoid Progenitor (CLP) ^{5,6,7,8,9,22}	Gives rise to all lymphoid cell types, as well as some DCs	T, B, NK, Dendritic			-	+	-	+	-						-																								
B,NK Progenitor (B,NK-P) ^{4,7}	Develops from CLPs or MLPs but does not produce T, myeloid or erythroid lineages	B, NK	0.05		-	+	+	+	-																														
Pro-B Progenitor ^{15,21,22}	Develops from MLPs, CLPs or B,NK-Ps	B			+	+																																	
Natural Killer Progenitor (NKP) ¹⁹	Develops from MLPs, CLPs or B,NK-Ps	NK			-	+	+	+																															
Pre-T⁺	* Committed T cell progenitor * Develops from lymphoid progenitors (i.e. CLPs or MLPs) which seed the thymus	T			+	+		-																															

* Cord blood frequency estimates are variable between different donor samples and are dependent on experimental conditions (reagents, staining, conditions, flow cytometer setup, gating) and subset frequencies. Expression of some markers in other tissues (e.g. fetal liver and bone marrow) may also be different.^{4,10,11,13,17} † Lineage markers include: CD2, CD3, CD11b, CD11c, CD14, CD16, CD19, CD24, CD56, CD66b, CD235. ‡ Not detectable in bone marrow-derived MLPs; only detectable in a fraction of cord blood-derived MLPs. § Not detectable in cord blood-derived CLPs^{6,8}, expressed in bone marrow-derived CLPs.^{5,7}

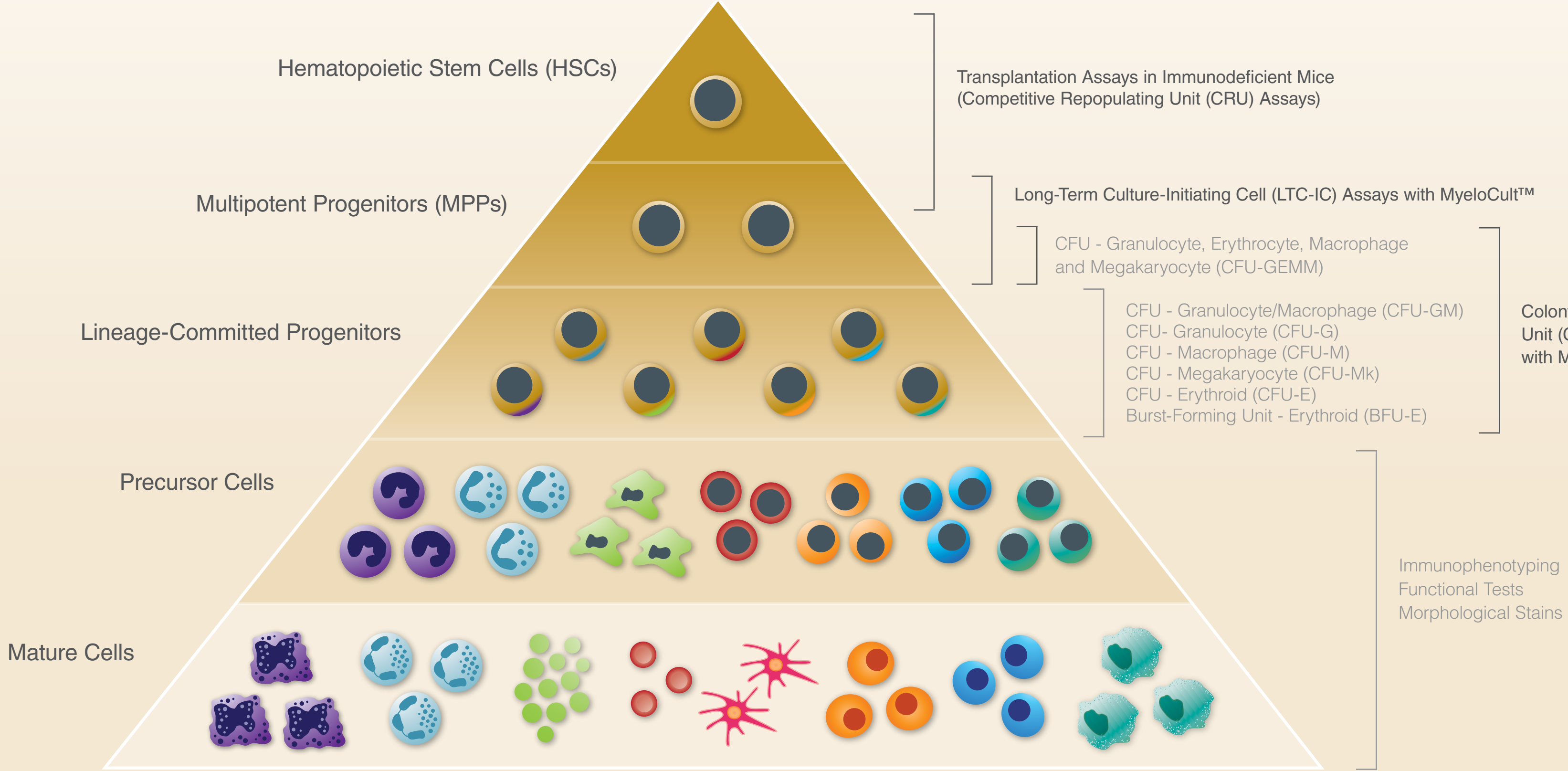
‡ Expressed in cord blood-derived CLPs^{6,8}; not detectable in bone marrow-derived CLPs.^{10,18} ¶ MEP are heterogeneous and may include CD71⁺CD41⁺ "pre-MEP" that have CFU-Mk, CFU-GM, CFU-GEMM and BFU-E/CFU-E potential, CD71⁺CD41⁺ erythroid-biased MEPs and CD71⁺CD41⁺ Mk-biased MEPs.¹⁸

B: B Lymphocyte, B,NK-P: B Lymphocyte, Natural Killer-Progenitor, BFU-E: Burst-Forming Unit - Erythroid, c-Kit: KIT Proto-Oncogene Receptor Tyrosine Kinase, CB: Cord Blood, CD: Cluster of differentiation, cDC: Pre-Conventional Dendritic Cell, CDP: Common Dendritic Cell Progenitor, CFU-E: Colony-Forming Unit - Erythroid, CFU-Mk: Colony-Forming Unit - Megakaryocyte, CLP: Common Lymphoid Progenitor, CMP: Common Myeloid Progenitor, DC: Dendritic Cell, FLT3: Fms-Related Tyrosine Kinase 3, GlyA: Glycophorin A, GM-CSFRα: Granulocyte-Macrophage Colony-Stimulating Factor Receptor Alpha Chain, GMDP: Granulocyte-Monocyte-Dendritic Cell Progenitor, GMP: Granulocyte-Macrophage Progenitor, HSC: Hematopoietic Stem Cell, HSPC: Hematopoietic Stem and Progenitor Cell, ic: Intracellular, IL-3Rα: Interleukin-3 Receptor Alpha Chain, IL-7Rα: Interleukin-7 Receptor Alpha Chain, IL: Interleukin, Lin: Lineage, M-CSFR: Macrophage Colony-Stimulating Factor Receptor, MDP: Monocyte-Dendritic Cell Progenitor, MEP: Megakaryocyte-Erythroid Progenitor, Mk: Megakaryocyte, MLP: Multilymphoid Progenitor, Mpl: Myeloproliferative Leukemia/Thrombopoietin Receptor, MPP: Multipotent Progenitor, NK: Natural Killer, NKP: Natural Killer Progenitor, NSG: Non-Obese Diabetic (NOD) Severe Combined Immunodeficiency (SCID) Gamma, pDC: Pre-Plasmacytoid Dendritic Cell, T: T Lymphocyte

Progenitor Subset Hierarchy



Hematopoietic Cell Compartments and Assays for Their Identification



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