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# CHAPTER 7

## CELL-SURFACE ANTIGENS

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### 1. INTRODUCTION

The cell surface is covered with protein molecules which are held in the membrane by hydrophobic transmembrane segments or glycosyl-phosphatidylinositol (GPI) anchors. Antigens found on cell surfaces comprise not only those encoded by the cell itself but also the products of intracellular parasites (e.g. glycoproteins of enveloped viruses). Furthermore, soluble ligands may be bound to receptor structures on the cell membrane, e.g. IgE bound to FcεR1 on mast cells, or lectin-like molecules bound to cell-surface carbohydrate structures. The molecules which form an integral part of the cell surface may be proteins, glycoproteins or glycolipids and, broadly, subserve one of three major functions: adhesion, antigen recognition or receptors for soluble mediators. However, many cell-surface molecules possess more than one function, e.g. molecules involved in cell-cell or cell-extracellular matrix adhesion can also themselves be involved in signal transduction.

While certain molecules, such as MHC class I encoded gene products, are extremely broad in their cellular distribution, others are highly restricted, e.g. TCR molecules are found exclusively on the surface of T lymphocytes. The expression of many cell-surface molecules is not only cell-lineage dependent but is also influenced by parameters such as stage of cell development ('differentiation antigens') or activation state ('activation antigens'). Many cell-surface antigens occur as allelic variants, MHC gene products being the extreme example. The genetic recombination and nucleotide additions (and somatic hypermutation for immunoglobulin genes) involved in the production of lymphocyte antigen receptors create further diversity at the surface of lymphocytes, as does alternative splicing (e.g. CD45 isoforms), and heterogeneous post-translational modifications (e.g. glycoforms of IgG). Although the number of any given molecule per cell is influenced by cell cycle and activation state, different cell-surface antigens are generally expressed at characteristic levels. For example, in the case of thymocytes, it has been estimated that there are approximately  $10^6$  molecules of CD90,  $10^5$  molecules of CD43 and  $10^4$  molecules of CD44 per cell (1).

The cell-surface antigens of leukocytes have been intensively studied due to ease of access to this cellular compartment. International workshops convened every few years assign a 'cluster of differentiation' (CD) nomenclature based on reactivity with groups of mAbs. Validation of CD antigens occurs when the cDNA is cloned and sequenced and then expressed to confirm its reactivity with the relevant mAbs. Antigens that remain to be fully characterized are given provisional workshop designations by the use of a 'w' before the assigned number, e.g. CDw12. The definitive reference works for the leukocyte cell-surface antigens are the *Leucocyte Typing* books published after each workshop, the most recent of which, *Leucocyte Typing V*, reports the results of the meeting held in November 1993 (2). In addition, a leukocyte differentiation antigen database (LDAD) has been compiled by Stephen Shaw. The LDAD program runs on IBM PCs (and via emulation on Macintosh) and may be downloaded freely by anonymous ftp from [balrog.nci.nih.gov](ftp://balrog.nci.nih.gov). Other excellent and comprehensive reviews dealing with leukocyte antigens have also been published recently (3,4). For details of

cell-surface antigens of rat, guinea-pig, hamster, dog, rabbit, birds, toad, pigs, cattle and sheep, the reader is directed to ref. 5.

Information relating to flow cytometric analysis of cell-surface antigens can be found in Chapter 4. The major characteristics of many of the known leukocyte cell-surface antigens are presented in the tables which follow this preamble. Although these lists are by no means exhaustive, they do cover most of the better-characterized antigens described in the literature. The biochemical characteristics are cataloged in *Table 1*, whereas *Table 2* deals with function and distribution. The reader should note that many of these molecules have several ligands, many of which may yet remain to be determined. The cell types listed under primary distribution are meant as a guide to the published distributions of these molecules on cells of the immune system; in many cases only a limited number of cell types has been examined. Functional aspects of most of these molecules also remain to be fully explored.

**Table 1.** Leukocyte cell-surface antigens – biochemical characteristics

Antigen	MW (kDa)	Chromosome		Membr. (#)	Glyco-N/O	Comments	Ref.
		Human	Mouse				
CD1a	49	1q22–q23	3	TM-I	4/–	Noncovalently linked to $\beta_2m$ ; similar structure to MHC class I but does not show significant polymorphism	6
CD1b	45	1q22–q23	3	TM-I	4/–		
CD1c	43	1q22–q23	3	TM-I	4/–		
CD2	45–58	1p13	3	TM-I	3/–	CD2R neo-epitope expressed on the CD2 molecule after cellular activation	7
CD3 $\gamma$	21–28	11q23	9	TM-I	2/–	$\zeta$ and $\eta$ alt. spl. from same gene; disulfide-linked $\zeta$ homodimer or $\zeta\eta$ heterodimer noncovalently associated with CD3 $\gamma,\delta,\epsilon$ and TCR $\alpha\beta$ or $\gamma\delta$ . $\zeta$ also associates with CD16	8
CD3 $\delta$	20–26	11q23	9	TM-I	2/–		
CD3 $\epsilon$	20–25	11q23	9	TM-I	–/–		
$\zeta$	16	1q22–q25	1	TM-I	–/–		
$\eta$	22	1q22–q25	1	TM-I	–/–		
CD4	55–59	12pter–p12	6	TM-I	2/–		9
CD5	67	11q13	19	TM-I	2/?	Co-precipitates with TCR/CD3 complex	10
CD6	100–130			TM-I	8/+		11
CD7	40	17q25		TM-I	2/?	Mouse has three potential N-linked glycosylation sites	12
CD8 $\alpha$	32–34	2p12	6	TM-I	–/+	Disulfide-linked $\alpha\beta$ heterodimers and $\alpha\alpha$ homodimers; also soluble forms by alt. spl.	13
CD8 $\beta$	32–34	2p12	6	TM-I	1/+		
CD9	22–27	12p13		TM (4)	1/+		14
CD10	100–110	3q21–q27		TM-II	6/?		15
CD11a	180	16p13.1–p11	12	TM-I	12/?	Noncovalent dimer with CD18	16
CD11b	170	16p13.1–p11	12	TM-I	19/?	Noncovalent dimer with CD18	
CD11c	150	16p13.1–p11	12	TM-I	8/?	Noncovalent dimer with CD18	

Table 1. Continued

Antigen	MW (kDa)	Chromosome		Membr. (#)	Glyco-N/O	Comments	Ref.
		Human	Mouse				
CDw12	90-120						17
CD13	150-160/chain	15q25		TM-II	11/+	Noncovalent homodimer	15
CD14	52-55	5q23-q31		GPI	4/?	+ Soluble forms	18
CD15	—	—	—	—	Antigen	On glycoproteins and glycolipids (e.g. CD11/CD18 integrins). CD15s is sialyl-CD15	19
CD15s	—	—	—	—	Antigen		
CD16	50-65	1q23-q24	1	TM-I	5/?	In man TM (FcγRIIIa) and GPI (FcγRIIIb) isoforms encoded by two linked genes; TM form noncovalently associated with a γ chain (also used by FcεR1) and ζ chain (also used by CD3) disulfide-linked homo- or heterodimers; also, soluble isoforms by proteolytic cleavage	20
CD16b	48	1q23-q24		GP1	5/?		
CDw17	—	—	—	—	Antigen	Glycosphingolipid	21
CD18	95	21q22.3		TM-I	6/?	Noncovalent dimers with CD11a,b,c	22
CD19	90-95			TM-I	5/?	Noncovalent complex with CD21, CD81 and Leu-13	23
CD20	33,35,37	11q12-q13.1	19	TM (4)	—/—	Isoforms due to different degrees of phosphorylation	24
CD21	145	1q32	1	TM-I	11-12/?	Two isoforms by alt. spl., also soluble form; complexes noncovalently with CD19, CD81 and Leu-13	23
CD22	130 α	19q13.1	7	TM-I	10/—	Non-covalently associated αβ heterodimer. α and β alt. spl. from same gene	25
	140 β	—	—	TM-I	11/—		

CD23	45-50	19p13.3	8	TM-II	1/?	Mouse has two potential N-linked glycosylation sites; two alt. spl. forms, FcεRIIa/FcεRIIb, differ in cytoplasmic region; high-affinity receptor is trimer or tetramer; also soluble forms	26
CD24	35-52			GPI	2/?		27
CD25	55	10p15-p14		TM-I	2/+	See: IL-2R	28
CD26	110-120	11pter-p11.2		TM-II	8/?	May exist as noncovalent trimer consisting of CD26 homodimer plus CD45	15
CD27	45-55/chain	12p13	6	TM-I	1/+	Disulfide-linked homodimer; also soluble form	29
CD28	44/chain	2q33	1	TM-I	5/?	Disulfide-linked homodimer	30
CD29	130	10p11.2		TM-I	12/?	Noncovalently associated with integrin α-subunits (CD49a-f)	31
CD30	105-120	1p36		TM-I	2/?	+ Soluble form	32
CD31	130-140			TM-I	9/?	Isoforms by alt. spl.	33
CD32	40	1q23-q24	1	TM-I	2/-	FcγRIIa, b and c forms encoded by three closely linked genes, show further variation by alt. spl. including soluble forms	20
CD33	67	19q13.3		TM-I	5/-		34
CD34	105-120	1q12-qter	1	TM-I	9/+		35
CD35	160-260	1q32	1	TM-I	20/?	Several cell surface and soluble forms	36
CD36	85-88	7		TM (2)	10/+		37
CD37	40-52	19p13-q13.4	7	TM (4)	3/-		38
CD38	45	4		TM-II	4/?		39
CD39	70-100				+/-		40

Table 1. Continued

Antigen	MW (kDa)	Chromosome		Membr. (#)	Glyco-N/O	Comments	Ref.
		Human	Mouse				
CD40	44-50	20	2	TM-I	2/-		41
CD41	123 $\alpha$ 23 $\beta$	17q21.32 -		- TM-I	4/? 1/?	Post-translationally cleaved into $\alpha\beta$ which are disulfide-linked; noncovalently associated with CD61	42
CD42a	17-23			TM-I	1/?	Tetramer of CD42a and CD42d noncovalently associated with disulfide-linked CD42b-CD42c $\alpha\beta$ heterodimer	43
CD42b	135-145	17pter-p12		TM-I	4/+		
CD42c	22-25	22		TM-I	1/?		
CD42d	80-85			TM-I	8/--		
CD43	95-135	16p11.2	7	TM-I	1/+	Range of glycoforms, also proteolytically cleaved soluble forms	44
CD44	85-250	11p13	2	TM-I	7/+	Several variants by alt. spl.; chondroitin sulfate linked at several sites. CD44R restricted epitope	45
CD45	170-240	1q31-q32	1	TM-I	11-16/+	Several variants by alt. spl.; may be noncovalently associated with CD26	46
CD45RA	205,220	1q31-q32	1	TM-I	11-16/+		
CD45RB	190,205,220	1q31-q32	1	TM-I	11-16/+		
CD45RO	180	1q31-q32	1	TM-I	11-16/+		
CD46	51-68	1q32		TM-I	3/+	Variants by alt. spl.	47
CD47	47-52	3q13.1-2		TM (5)	+/?	Associated with CD51/CD61 VNR	48
CD48	40-47	1q21.3-q22	1	GPI	6/?		49

CD49a	210	5		TM-I	24/?	CD49 molecules are noncovalently associated with integrin $\beta$ 1 subunit (CD29) to form VLA1-6; $\alpha\beta$ -subunits post-translationally cleaved and disulfide-linked	50
CD49b	160-165	5q23-q31		TM-I	10/?		
CD49c	110 $\alpha$	17		-	}13/?		
	30 $\beta$	-		TM-I	}		
CD49d	150 uncleaved	2q31-q32	9	TM-I	11/?		
	80 $\alpha$	-		-	6/?		
	70 $\beta$	-		TM-I	5/?		
CD49e	135 $\alpha$	12q11-q13		-	14/?		
	25 $\beta$	-		TM-I	-/?		
CD49f	125 $\alpha$	2		-	8/?		
	30 $\beta$	-		TM-I	2/?		
CD50	116-140			TM-I	15/?		51
CD51	125 $\alpha$	2q31-q32		-	10/?	Post-translationally cleaved, $\alpha\beta$ disulfide-linked, noncovalently associated with CD61	52
	24 $\beta$	-		TM-I	3/?		
CD52	21-28			GPI	1/?		53
CD53	32-42	1p31-p12	3	TM (4)	2/?		38
CD54	85-110	19p13.2	9	TM-I	8/?	+ Soluble form	54
CD55	64-75	1q32		GPI	1/+	+ Soluble forms	55
CD56	140	11q23-q24	9	TM-I	6/?	Isoforms by alt. spl., yielding further variants by post-translational modifications; other isoforms by alt. spl. not on leukocytes (e.g. 180 kDa on neural tissue)	56
	120	11q23-q24	9	GPI	6/?		
CD57	-	-	-	-	Antigen	Present on several different molecules	57
CD58	55, 70	1p13		GPI/ TM-I	6/?	TM or GPI isoforms by alt. spl. + soluble form	58
CD59	18-20	11p14-p13		GPI	1/?		59
CDw60	-	-	-	-	Antigen		60



Table 1. Continued

Antigen	MW (kDa)	Chromosome		Membr. (#)	Glyco-N/O	Comments	Ref.
		Human	Mouse				
CD61	105-110	17q21.32		TM-I	6/?	Noncovalently associated with CD41 to give GPIIb-IIIa complex or with CD51 to give vitronectin receptor	52
CD62E	107-115	1q12-qter		TM-I	11/?	Glycoforms and soluble form	61
CD62L	74-100	1q23-q25		TM-1	7/-	+ Soluble form	
CD62P	140-150	1q21-q24		TM-1	12/?	? Oligomeric. Also soluble form by alt. spl.	
CD63	53	12q12-q13		TM (4)	3/?		62
CD64	72-75	1q21.2-q21.3	3	TM-I	7/?	Fc $\gamma$ RIa, b and c forms encoded by three closely linked genes. Also soluble isoforms	20
CDw65	-	-	-	-	Antigen		63
CD66a	160-190			TM-I	20/?	Members of NCA subgroup of CEA molecules.	64
CD66b	95-110			GPI	11/?	Isoforms by alt. spl. described for most of these molecules	
CD66c	90			GPI	+/?		
CD66d	30			TM-I	2/?		
CD66e	180-200	19q13.1-q13.2		GPI	+/?		
CD68	110			TM-I	9/?	? Isoforms by alt. spl. Also soluble form	65
CD69	34/28	12p13-p12	8	TM-II	1/?	Disulfide-linked 'homodimer' of two glycoforms	66
CD70	55,75,95,110,170	19p13		TM-II			67
CD71	95/chain	3q26.2-qter		TM-II	3/+	Disulfide-linked homodimer. Also soluble form	68
CD72	42/chain	9p	4	TM-II	1/?	Disulfide-linked homodimer	69

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CD73	69–74	6q14–q21		GPI	4/?	Disulfide-linked homodimer	15
CD74	43,41,35,33	5q32	18	TM-II	2–4/+	Two initiation codons + alt. spl. yield four isoforms. Mostly intracellular but some on cell surface	70
CDw75	–	–	–	–	Antigen	Sialic acid-dependent determinant	71
CDw76	–	–	–	–	Antigen	Sialic acid-dependent determinant	72
CD77	–	–	–	–	Antigen	Neutral glycosphingolipid	73
CDw78							74
CD79a	32–45			TM-I	6/?	Disulfide-linked CD79a/CD79b heterodimer noncovalently associated with mIg. CD79a smaller in mice due to only two potential N-linked glycosylation sites. Truncated isoform of CD79b ('Ig-γ')	75
CD79b	36–38	17q23		TM-I	3/?		
CD80	60	3q13.3–q21		TM-I	8/?		76
CD81	22–26	11p	7	TM (4)	–/–	Noncovalent complex with CD19, CD21 and Leu-13	77
CD82	50–53						78
CD83	40–45			TM	3/?		79
CDw84	73						80
CD85	83–120						80
CD86	80						80
CD87	50–56			GPI	5/?		81
CD88	40	19q13.3		TM (7)	1/?		82
CD89	50–70	19q13.4		TM-I	5/?		83
CDw90	19–35	11q22.3–q23	9	GPI	3/–	Noncovalently associated with Sca-1	84

Table 1. Continued

Antigen	MW (kDa)	Chromosome		Membr. (#)	Glyco-N/O	Comments	Ref.
		Human	Mouse				
CD91	$\alpha$ 500 $\beta$ 85	12q13-q14		— TM-I	52/?	Post-translationally cleaved into $\alpha\beta$ subunits. $\alpha$ -subunit noncovalently linked to TM $\beta$ -subunit	85
CDw92	70						2
CD93	120						2
CD94	43/chain					Disulfide-linked homodimer	86
CD95	42-43	10q24.1	19	TM-I	2/?		87
CD96	160			TM-I	15/+		88
CD97	74,80,89						2
CD98	80-85 40	11q12-q22 11q12-q22		TM-II	4/? -/-	Disulfide-linked heterodimer	89
CD99	32	Xpter-p22.32 Ypter-p11.2		TM-I	-/+	Pseudoautosomal. CD99R restricted epitope	90
CD100	150/chain				+/+	Disulfide-linked homodimer	91
CDw101	140						92
CD102	55-65	17q23-q25		TM-I	6/?		93
CD103	150			TM-I		Heterodimer with integrin $\beta^7$	94
CD104	220			TM-I	5/?		95
CD105	95/chain			TM-II	5/+	Disulfide-linked homodimer. Variants by alt. spl.	96
CD106	90, 110	1p32-p31	3	GPI/ TM-I	5-6/?	Isoforms by alt. spl. + soluble form	97

CD107a	90–120	13q34		TM-I	17–20/+	Bear bulky poly- <i>N</i> -acetylglucosamines	98
CD107b	95–120	Xq24–q25		TM-I	16–17/+		
CD108	80						99
CD109	150, 170						100
CD115	150	5q33.2–q33.3	18	TM-I	11/?		101
CDw116	70–85	Xp22.32 Yp11.3	19	TM-I	11/?	Pseudoautosomal $\alpha$ -chain of GM-CSFR non-covalently associates with $\beta$ -subunit common to IL-3R and IL-5R. $\alpha$ -chain constitutes low aff. receptor, $\alpha\beta$ high aff. receptor. + soluble form of $\alpha$ -chain by ? alt. spl.	102
CD117	145	4q11–q22	5	TM-I	10/?		103
CDw119	90–100	6q23–q24	10	TM-I	5/?	+ Soluble form	104
CD120a	50–60	12p13.2	6	TM-I	3/–	+ Soluble forms by proteolytic cleavage	105
CD120b	75–85	1p36.3–p36.2	4	TM-I	2/?		
CDw121a	80	2q12	1	TM-I	6/?	IL-1R: two types encoded by linked genes. Soluble form of CDw121b by proteolytic cleavage	106
CDw121b	60–70	2q12–q22	1	TM-I	5/?		
CDw122	75	22q11.2–12	15	TM-I	4/?	See IL-2R	28
CDw124	130–150	16p12.1–11.2	7	TM-I	6/?	IL-4R. Associates with a $\gamma$ -chain shared with IL-2R and IL-7R. + Soluble form by alt. spl.	107
CD126	80	1q21	3	TM-I	5/?	IL-6R $\alpha$ -chain. Low aff. receptor. Noncovalent heterodimer with CDw130 forms high aff. receptor. Soluble form by proteolytic cleavage.	108
CDw127	70–80	5p13	15	TM-I	5/?	IL-7R. Associates with a $\gamma$ -chain shared with IL-2R and IL-4R. + Soluble form by alt. spl.	109
CDw128	44–58	2q34–q35		TM (7)	4/?	IL-8RI	110
	67–70	2q34–q35		TM (7)	3/?	IL-8RII	

Table 1. Continued

Antigen	MW (kDa)	Chromosome		Membr. (#)	Glyco-N/O	Comments	Ref.
		Human	Mouse				
CDw130	130			TM-I	10/?	IL-6R, IL-11R and LIF-R $\beta$ -chain.	108
2B4	66		1	TM			111
4-1BB	30-40			TM-I	2/?	Monomeric and dimeric forms	112
114-A10	150			TM-I	3/?	8 Glucosaminoglycan attachment sites	113
A15	36			TM (4)	4/?		114
APA	130-160/chain			TM-II	9/?	Disulfide-linked homodimer. Molecular weight variants are glycoforms	15
B7-2	60-100			TM-I	8/?		115
C-CAM	105			TM-I	16/?	C-CAM1 and C-CAM2 isoforms differ in cytoplasmic domain	116
CD40L	32-39	Xq26.3-q27.1	X	TM	+/?		117
CLA	Multiple			TM (2)	10/?	Isoforms by alt. spl. and glycoforms	118
CMRF35	25-50			TM-I	2/+		119
CTLA-4	26-27/chain	2q33	1	TM-I	1/?	Disulfide-linked homodimer	120
EPO-R	66	19p13.2	9	TM-I	1/-		121
Fc $\epsilon$ RI $\alpha$	45-65	1q23	1	TM-I	6/?	Disulfide-linked $\gamma$ homodimer associated noncovalently with an $\alpha$ - and $\beta$ -chain. $\gamma$ -chain also associates with CD16	122
$\beta$	32-33	1q23	1	TM (4)	2/?		
$\gamma$	7-12	1q23	1	TM-I	-/-		
flk-2				TM-I	9/?		123

fMLP-R	55-70	19q13.3		TM (7)	3/?		124
G-CSFR	130-150	1p35-p34.3	4	TM-I	9/?	Two isoforms with different length cytoplasmic regions and also soluble form by ?alt. spl.	125
gp42	40-45			GPI	3/?		126
gp49	49			TM-I	3/-		127
IgH	IgM 70	14q32.33	12	TM-I	5/-	Diverse disulfide-linked tetramers of two identical polypeptide heavy chains and two identical polypeptide light chains. Can have additional V region glycosylation. Multiple C region glycoforms. Soluble forms by alt. spl., GPI-linked isoform of IgD	128
	IgD 50-63	14q32.33	12	TM-I	7/-		
Igκ	25-28	2p12	6	-	-/-		
Igλ	25-28	22q11.2	16	-	-/-		
IL2-R α	55	10p15-p14		TM-I	2/+	α-chain (CD25) is low affinity IL-2R. β (CDw122)/γ dimer is int. aff. IL-2R, αβγ trimer is high aff. IL-2R. Chains noncovalently associated. Also soluble forms. γ-chain also used by IL-4R and IL-7R	28
β	75	22q13	15	TM-I	4/?		
γ	64	Xq13.1		TM-I	6/?		
IL-3R α	70	Yp13.3, Xp22.3		TM-I	6/?	Specific pseudoautosomal α-chain + noncovalently linked β-chain common to IL-5 and GM-CSF receptors. α-chain constitutes low aff. receptor, αβ high aff. receptor	102
β	120-140	22q13.1	15	TM-I	3/?		
IL-5R α	55-60	3p26	6	TM-I	6/?	Specific α-chain + noncovalently linked β-chain common to IL-3 and GM-CSF receptors. α-chain constitutes low aff. receptor, αβ high aff. receptor; soluble form by alt. spl.	129
β	120-140	22q13.1	15	TM-I	3/?		
IL-9R	64						130
IL-10R							131
IL-11R	151					Noncovalent heterodimer with CDw130	130

Table 1. Continued

Antigen	MW (kDa)	Chromosome		Membr. (#)	Glyco-N/O	Comments	Ref.
		Human	Mouse				
IL-12R	110-135						132
IL-13R							133
Integrin $\alpha^7$	120-180			TM-I			95
Integrin $\beta^7$	120	12q13.13	15	TM-I	8/?		95
LAG-3	50-70	12p13.3		TM-I	4/?		134
LDL-R	160	19p13.2	9	TM-I	5/+		135
Leu-13						Noncovalent complex with CD19, CD21 and CD81	136
LIF-R	190	5p13-p12	15	TM-I	20/?	Noncovalent heterodimer with CDw130. Soluble isoform in mouse by alt. spl.	137
Itk	100	15q13-q21		TM-I	3/?		138
Ly-9	100		1	TM-I	8/?		139
Ly-49	44		6	TM-II	3/?	Disulfide-linked homodimer. Several isoforms	140
M6	42-54			TM-I	3/?		141
M130	130			TM-I	11/?	Isoforms by alt. spl.	142
Mac-2	29-35			—	—/?	No membrane anchor, presumably bound to other surface molecules. Isoforms by alt. spl.	143
MAFA-G63	28-40						144
Mannose-R	175-190			TM-I	8/?		145

M-ASGP-BP	42			TM-II	2/?	Functionally active form is a homo-hexamer or homo-octamer	146
MDR1	170	7q21.1	5	TM (12)	3/?		147
MHC I $\alpha$	44	6p21.3	12	TM-I	1/-	$\alpha$ -chain highly polymorphic, non-covalently associated with nonpolymorphic $\beta_2$ -microglobulin	148
$\beta_2m$	12	15q21-q22.2	2	-	-/-		
MHC II $\alpha$	32-35	6p21.3	17	TM-I	2/-	Highly polymorphic, noncovalently associated $\alpha\beta$ heterodimer	149
$\beta$	28-32	6p21.3	17	TM-I	1/-		
MKW	52			TM	-/-		150
MPL	65-90	1p34	4	TM-I	4/?	Two isoforms, MPLP and MPLK, differ in length of cytoplasmic region	151
MRC OX-2	40-50	3		TM-I	6/-		152
MRC OX-40	47-51			TM-I	1/?		153
NB1	58-64			GPI	+/?		154
NK1.1	30-39/chain		6	TM-II		Disulfide-linked homodimer	140
NKG2	35-40?	12		TM-II	3/?	Identified by cDNA. Prob. disulfide-linked homodimer. Four or five linked genes	155
PAF-R	39-50	1		TM (7)	2/?		156
PC-1	115-120			TM-II	10/?	Disulfide-linked homodimer	157
R2	40-50	11p12		TM (4)	3/?		38
RT6.1	24-35		7	GPI	1/?		158
6.2	25-28		7	GPI	-/-		
Sca-1	12-18		15	GPI	-/?	Several isoforms encoded by linked genes. Noncovalently associated with CDw90	159



Table 1. Continued

Antigen	MW (kDa)	Chromosome		Membr. (#)	Glyco-N/O	Comments	Ref.
		Human	Mouse				
Scav R	77	8p22		TM-I	7/?	Trimers, ? homo-, ? hetero-	160
SN8	$\alpha$ 49 $\beta$ 40					Disulfide-linked $\alpha\beta$ heterodimer	161
Syndecan	80-120			TM-I	1/+	Bears five glycosaminoglycans	162
TCR $\alpha$	40-45	14q11.2	14	TM-I	5/-	Diverse disulfide-linked $\alpha\beta$ heterodimers. 'Pre-TCR' may consist of $\beta$ -chain homodimers. Various soluble forms of TCR described but significance controversial	8
TCR $\beta$	38-45	7q35	6	TM-I	2/-		
TCR $\gamma$	45-60	7p15	13	TM-I	4/-	Diverse disulfide-linked and noncovalently linked $\gamma\delta$ heterodimer isoforms	8
TCR $\delta$	40-45	14q11.2	14	TM-I	2/-		
TGF $\beta$ -R	53-300			TM-I	3-6/?	Several isoforms. Type III has up to five glycosaminoglycan chains attached. Also soluble form	163
TSA-1	12-13			GPI			164

MW: Typical molecular weight obtained on an SDS-PAGE gel run under reducing conditions.

Membr., membrane association. TM-I, type-I (C-terminus cytoplasmic) transmembrane; TM-II, type-II (N-terminus cytoplasmic) transmembrane. For molecules which pass through the membrane more than once, the number (#) of transmembrane regions is given in parentheses. GPI, glycosyl-phosphatidylinositol anchor. -, associated with a membrane-bound chain.

Glyco-N, number of consensus sequences for nitrogen-linked glycosylation; Glyco-O, oxygen-linked glycosylation (+, yes; -, no; ?, not known); Glyco-Antigen, carbohydrate antigen.

alt. spl., alternative splicing.

**Table 2.** Leukocyte cell-surface antigens – functions and distribution

Antigen	Synonyms	Ligand(s)	Primary distribution	Function
CD1a	T6, Ly-38 (mouse)	Peptides?	Cort. Thy, DC, NK	Ag presentation?
CD1b		Peptides?	Cort. Thy, DC	Ag presentation?
CD1c		Peptides?	Cort. Thy, DC, B-sub, NK	Ag presentation?
CD2	Sheep erythrocyte (SRBC) receptor, LFA-2, T11, Leu-5, Tp50, Ly-37 (mouse), MRC OX54 (rat)	CD48, CD58, CD59, SRBC	Thy, T, NK-sub, BM, Mono, mouse, B, rat Macro	Adhesion, signaling
CD3 $\gamma$	CD3 complex, T3	–	Thy, T	TCR signal transduction
CD3 $\delta$			Thy, T	
CD3 $\epsilon$			Thy, T	
$\zeta$			Thy, T, NK	
$\eta$			Thy, T	
CD4	T4, Leu-3, L3T4 (mouse), Ly-4 (mouse), W3/25 (rat), MRC OX35 (rat)	MHC class II, HIV-1, HIV-2	Thy, T-sub, DC, human and rat Mono, human and rat Macro	Adhesion, signaling. Accessory molecule for TCR–MHC class II interaction
CD5	T1, Leu-1, Ly-1 (mouse), Lyt-1 (mouse), LyA (mouse), MRC OX19 (rat)	CD72	Thy, T, B-sub	Signaling
CD6	T12		Thy, T-sub, B-sub	? Signaling
CD7	gp40		Thy, T-sub, NK, pluripotent hematopoietic cells	
CD8 $\alpha$	T8, Leu-2, Ly-2/Ly-3 (mouse), Lyt-2/Lyt-3 (mouse), LyB/LyC (mouse), MRC OX8 (rat)	MHC class I	Thy, T-sub, NK-sub, rat NK	Adhesion, signaling. Accessory molecule for TCR–MHC class I interaction

Table 2. Continued

Antigen	Synonyms	Ligand(s)	Primary distribution	Function
CD9	Motility-related protein-1 (MRP-1), p24		Pre-B, Mono, Pt, Eosino, Baso, T-act, Endo, BM	Adhesion, signaling
CD10	Common acute lymphoblastic leukemia antigen (CALLA), enkephalinase, neutral endopeptidase (NEP), metalloendopeptidase	Peptides, f-Met-Leu-Phe (f-MLP)	Pre-B, Pre-T, Neutro, B blasts, BM stroma	Zinc metalloprotease
CD11a	Leukocyte function-associated antigen-1 (LFA-1), LeuCAMA (CD11a/CD18), integrin $\alpha^L$ subunit, Ly-15 (mouse), WT.1 (rat)	CD50 (ICAM-3), CD54 (ICAM-1), CD102 (ICAM-2)	T, B, Neutro, Mono, Macro, NK, BM	Adhesion
CD11b	Mac-1, CR3, LeuCAMb, integrin $\alpha^M$ subunit, Mo-1, OKM-1 (CD11b/CD18), Ly-40 (mouse), MRC OX41 (rat)	C3bi, fibrinogen, CD54, factor X	Mono, Neutro, NK, T-sub, Macro-sub, FDC	Adhesion, complement receptor
CD11c	CR4, integrin $\alpha^x$ subunit, p150 (p150,95), LeuCAMc (CD11c/CD18)	C3bi, fibrinogen	Macro, Mono, Neutro, NK, B-act, T-act	Adhesion, complement receptor
CDw12	p90-120		Mono, Neutro	
CD13	Aminopeptidase N (APN), MY7 antigen, coronavirus receptor	Peptides, coronavirus	Mono, Baso, Eosino, Neutro, Endo, BM stroma	Zinc metalloprotease

CD14	LPS–BP receptor	LPS, LPS–LPS binding protein (LBP) complex, LPS–Septin complex	Mono, Macro-sub, LC, FDC, Neutro, human B-sub	? Clearance of LBP-opsionized Gram –ve bacteria. Signaling
CD15	Lewis <sup>x</sup> (Le <sup>x</sup> ), 3-fucosyl- <i>N</i> -acetyl-lactosamine (FAL)	Homotypic	Neutro, Eosino, Mono-sub	Adhesion
CD15s	Sialyl-Lewis <sup>x</sup>	CD62E	NK, Neutro, Mono	Adhesion
CD16a	FcγRIIIa, Leu-11	Human: IgG1 = IgG3 > > > IgG2, IgG4.	CD16a TM isoform: NK, Macro, Mono-sub, Mono-act, T-sub, FDC,	Low affinity receptor for complexed IgG. Signaling
CD16b	FcγRIIIb	Mouse: IgG3 > IgG2a > IgG2b > > IgG1	mouse Neutro CD16b GPI isoform: human Neutro, human Eosino-act	
CDw17	Lactosylceramide		Mono, Pt, Neutro	? Adhesion
CD18	Integrin β <sup>2</sup> subunit, WT.3 (rat)	CD54, CD102, C3bi	Leuko (see CD11)	Adhesion
CD19	B4		B, FDC	Antigen co-receptor, signaling
CD20	B1, Ly-44 (mouse)		B, FDC	? Signaling
CD21	CR2, Epstein–Barr virus (EBV) receptor, B2, HB5	iC3b, C3d, C3dg, EBV, CD23, IFNα	Thy-sub, B-mat, FDC	Complement receptor, adhesion, signaling
CD22	B-lymphocyte cell adhesion molecule (BL-CAM), Lyb-8 (mouse)	Sialylated glycoproteins, CD75, CD45RO	B-sub	Adhesion, signaling
CD23	FcεRII, BLAST-2, B6, Leu-20, Ly-42 (mouse)	IgE, CD21	FcεRIIIa: B FcεRIIIb: Mono-act, Eosino, FDC-sub, T, Pt, LC, NK	Low affinity receptor for IgE. Adhesion, signaling. FcεRIIIb form not found in mice, and in man it is dependent on IL-4 for expression

Table 2. Continued

Antigen	Synonyms	Ligand(s)	Primary distribution	Function
CD24	BA-1, heat-stable antigen (HSA) (mouse), J11d (mouse), B2A2 (mouse), M1/69 (mouse), Ly-52 (mouse)		B, Neutro, FDC-sub, Thy (mouse), BM (mouse)	? Signaling, ? adhesion
CD25	IL-2R $\alpha$ subunit, Tac, p55, Ly-43 (mouse), MRC OX39 (rat)	IL-2	T-act, B-act, Mono-act	Cytokine receptor subunit, signaling
CD26	Dipeptidyl aminopeptidase IV (DPP4), thymocyte-activating molecule (THAM) (mouse), MRC OX61 (rat)	Peptides, collagen, fibronectin	Thy, T-sub, Macro, Endo	Protease, adhesion, ? signaling
CD27		CD70 (CD27 ligand)	Medullary Thy, T-act, B-act, PC	Adhesion, ? signaling
CD28	Tp44	CD80 (B7-1), B7-2	Thy, T-sub, B-act, PC	Signaling
CD29	Very late antigen (VLA) $\beta$ -subunit, platelet glycoprotein (Pt-GP) II $\alpha$ , integrin $\beta^1$ -subunit, fibronectin receptor (FNR) $\beta$ -subunit	Fibronectin, collagen, laminin, vascular cell adhesion molecule-1 (VCAM-1)	Broad	Adhesion, signaling
CD30	Ki-1, Ber-H2 antigen	CD30 ligand (CD30L)	T-act, B-act, Endo	
CD31	Platelet-endothelial cell-adhesion molecule-1 (PECAM-1), endoCAM	Homophilic (and heterophilic)	Pt, Mono, Neutro, Eosino, T-sub, Endo, BM	Adhesion
CD32	Fc $\gamma$ RII, Ly-17 (mouse), Lym-20 (mouse)	Human: IgG3 $\geq$ IgG1 $\geq$ IgG2, IgG4 Mouse: IgG2a = IgG2b $\geq$ IgG1	Macro, Mono, Neutro, B, Eosino, Endo, Baso, Pt, LC, FDC	Low-affinity receptor for complexed IgG. Signaling

CD33	MY9 antigen, gp67			Mono, Neutro, BM (myeloid precursors)	? Adhesion, ? signaling
CD34	gp105-120	CD62L		Immature hematopoietic cells, Endo	
CD35	CR1	C3b, iC3b, C3c, C4b		Neutro, Eosino, Mono, T-sub, B, NK-sub, RBC, FDC	Complement receptor, adhesion
CD36	Pt-GPIV, GPIIb, OKM5 antigen	Thrombospondin, collagen, sequesterin, <i>Plasmodium falciparum</i> -infected RBC		Mono, Macro, Pt, small vessel endo, BM	Adhesion
CD37				B-mat, T-sub, Neutro, Mono, BM	
CD38	T10			Thy, Pre-B, T-act, B-act, PC, FDC, NK-sub, Neutro, Mono	
CD39				NK-act, T-act, B-act, Neutro, Mono, Macro, LC, FDC	? Adhesion
CD40		CD40 ligand (CD40L, TNF-related activation protein (TRAP), gp39, T-BAM)		B, thymic epith, FDC, Mono, Pt	Signaling
CD41	Pt-GPIIb, integrin $\alpha^{IIb}$	Fibrinogen, fibronectin, vitronectin, von Willebrand factor, thrombospondin		Pt, Megakaryo, Mono	Platelet aggregation
CD42a	Pt-GPIX	von Willebrand factor, thrombin		Pt, Megakaryo, Mono	Adhesion
CD42b	Pt-GPIb $\alpha$ , glyocalicin	von Willebrand factor, thrombin		Pt, Megakaryo, Endo, Mono, Neutro, B-act	Adhesion

**Table 2.** Continued

Antigen	Synonyms	Ligand(s)	Primary distribution	Function
CD42c	Pt-GPIb $\beta$	von Willebrand factor, thrombin	Pt, Megakaryo, Endo	Adhesion
CD42d	Pt-GPV	von Willebrand factor, thrombin	Pt, Megakaryo, Mono	Adhesion
CD43	Leukosialin, Sialophorin, Ly-48 (mouse), W3/13 (rat)	CD54 (ICAM-1)	Thy, T, NK, Macro, Mono, Neutro, PC, Pt, B-act, BM, DC	Adhesion, ? signaling
CD44	Phagocyte glycoprotein-1 (Pgp-1), extracellular matrix receptor-III (ECMR-III), HERMES, H-CAM, HUTCH-1, Ly-24 (mouse), MRC OX50 (rat)	Hyaluronate, collagen, fibronectin, MIP-1 $\beta$ chemokine	Broad	Lymphocyte adhesion to HEV, ? signaling
CD45	Leukocyte common antigen (LCA), B220, T200, Ly-5 (mouse), MRC OX1 (rat)	Phosphotyrosine	Leuko	Phosphatase, signaling
CD45RA	Restricted LCA	Phosphotyrosine	T-sub, B, Mono, BM	
CD45RB	Restricted LCA	Phosphotyrosine	T-sub, B, Neutro, Mono, NK, BM	
CD45RO	Restricted LCA	Phosphotyrosine, CD22	T-sub, B, Neutro, Mono, NK, Pt, BM	
CD46	Membrane cofactor protein (MCP), measles virus receptor	C3b, C4b, measles virus	Broad	Cofactor for cleavage of C3b and C4b
CD47	gp42, neurophilin, integrin-associated protein (IAP), OA3, GR63, ID8		Broad	Adhesion, signaling
CD48	Blast-1, BCM1 antigen (mouse),	CD2	Leuko	Adhesion, ? signaling

	Sgp-60 (mouse), MRC OX-45 (rat)			
CD49a	VLA- $\alpha$ 1, integrin $\alpha^1$ subunit	Laminin, collagen	T-act, Mono, NK	Adhesion, signaling
CD49b	VLA- $\alpha$ 2, integrin $\alpha^2$ subunit, Pt-GPI $\alpha$ , ECMR-I	Laminin, collagen	Leuko, Pt, Endo	Adhesion, signaling
CD49c	VLA- $\alpha$ 3, integrin $\alpha^3$ subunit, ECMR-II	Fibronectin, laminin, collagen, invasin, epiligrin	B, FDC, Endo, NK	Adhesion, signaling
CD49d	VLA- $\alpha$ 4, integrin $\alpha^4$ subunit, LPAM- $\alpha$ 1	VCAM-1, fibronectin	Mono, T, B, Thy, Pt, NK, Eosino, FDC	Adhesion, signaling
CD49e	VLA- $\alpha$ 5, integrin $\alpha^5$ subunit, FNR $\alpha$ -chain	Fibronectin	Broad	Adhesion, signaling
CD49f	Pt-GPIc, ECMR-IV, VLA- $\alpha^6$ , integrin $\alpha^6$ subunit	Laminin, invasin	Pt, Mono, T, Thy, FDC, Endo, NK	Adhesion, signaling
CD50	ICAM-3, ICAM-R	CD11a/CD18 (LFA-1)	Leuko	Adhesion
CD51	Integrin- $\alpha^v$ subunit, vitronectin receptor (VNR) $\alpha$ -chain	Vitronectin, fibrinogen, von Willebrand factor, thrombospondin, fibronectin, osteopontin, collagen	Pt, B-sub, Endo, Mono, Macro, Megakaryo	Adhesion
CD52	Campath-1 antigen		Leuko	
CD53	MRC OX44 (rat)		Leuko, BM, Pt	
CD54	Intercellular adhesion molecule-1 (ICAM-1), MALA-2, rhinovirus receptor, Ly-47 (mouse), 1A29 (rat)	CD11a/CD18 (LFA-1), rhinovirus, CD43, CD11b/CD18 (Mac-1), <i>Plasmodium falciparum</i> -infected RBC	Broad	Adhesion, ? signaling
CD55	Decay accelerating factor (DAF)	C3b, C4b, C3 convertases	Broad	Adhesion, ? signaling. Prevents formation of C4b2a and C3bBb



**Table 2.** Continued

<b>Antigen</b>	<b>Synonyms</b>	<b>Ligand(s)</b>	<b>Primary distribution</b>	<b>Function</b>
CD56	Neural cell adhesion molecule (NCAM) isoform, NKH-1, Leu-19	Homophilic, heparin sulfate, heparin	NK, T-sub(act)	Adhesion
CD57	HNK-1, Leu-7		NK, T-sub, B-sub, Mono-sub	
CD58	LFA-3, H19, Fib75	CD2	Broad	Adhesion
CD59	TAP, protectin, homologous restriction factor (HRF) 20, membrane inhibitor of reactive lysis (MIRL), MACIF	CD2	Broad	Adhesion, ? signaling. Binds C8 and C9 and thereby inhibits MAC assembly
CDw60	GD3, NeuAc2-8NeuAc2-3Gal $\beta$ 1-4, UM4D4		T-sub, Mono, Pt	? Signaling
CD61	Pt-GPIIIa, VNR $\beta$ -chain, integrin $\beta^3$ subunit	Fibrinogen, fibronectin, vitronectin, von Willebrand factor, ? thrombospondin, ? vitronectin, ? osteopontin, ? collagen	Mono, Macro, Megakaryo, Pt, Endo	Adhesion
CD62E	E-selectin, endothelial leukocyte adhesion molecule-1 (ELAM-1), LECAM-2	CD15s, CD62L, CDw65, CLA, fucosylated <i>N</i> -acetyl lactosamine	Endo-act	Adhesion
CD62L	L-selectin, leukocyte adhesion molecule-1 (LAM-1), LECAM-1, MEL-14, Leu-8, lymph node homing receptor (LHR), Ly-22 (mouse), TQ-1, DREG-56	GlyCAM-1, CD34	Leuko	Adhesion

CD62P	P-selectin, GMP140, PADGEM, LECAM-3	Sialylated fucosylated lactosaminoglycans (e.g. CD15 s, CDw65)	Pt-act, Endo, Megakaryo	Adhesion
CD63	MLA1, PTLGP40, ME491, neuroglandular antigen, LIMP		Broad	Adhesion
CD64	Fc $\gamma$ RI	Human: IgG3 > IgG1 > IgG4 > > > IgG2 Mouse: IgG2a = IgG3 > > > IgG1, IgG2b	Macro, Mono, Neutro-act, Eosino-act	High-affinity receptor for IgG. Signaling
CDw65	Ceramide dodecasaccharide 4c, VIM-2	CD62E, CD62P	Neutro, Eosino	
CD66a	Biliary glycoprotein-1 (BGP-1) NCA-160	Homotypic	Neutro	Adhesion, ? signaling
CD66b	CD67, p100, CGM6, NCA-95		Neutro, Eosino	Adhesion, ? signaling
CD66c	NCA-90	Homotypic	Neutro	Adhesion
CD66d	CGM1		Neutro	Adhesion, ? signaling
CD66e	Carcinoembryonic antigen (CEA)	Homotypic	Neutro	Adhesion
CD68	gp 110, macroscialin (mouse)		Macro, Mono, Neutro, Baso, large lympho	
CD69	Activation inducer molecule (AIM), EA-1, MLR-3, Leu-23, VEA		Thy, T-act, B-act, Macro, NK-act, Pt	Signaling
CD70	CD27 ligand	CD27	T-act, B-act	? Signaling
CD71	Transferrin receptor, T9, MRC OX26 (rat)	Transferrin	Macro, all proliferating cells, Endo, FDC	? Signaling, iron uptake
CD72	Lyb-2 (mouse)	CD5	B, Macro	? Signaling
CD73	Ecto-5'-nucleotidase (E5N)	Nucleoside monophosphate	Thy, B-sub, T-sub, Endo-sub, FDC-sub	Enzyme, ? signaling, ? adhesion

Table 2. Continued

Antigen	Synonyms	Ligand(s)	Primary distribution	Function
CD74	Invariant chain (Ii)	Intracellular MHC class II	T-act(sub), B, Mono, Macro	Regulates MHC class II folding, transport and peptide binding
CDw75		CD22	B-mat, T-sub	Adhesion
CDw76			B-mat, T-sub, Endo-sub	
CD77	Globotriacylceramide (Gb3), Burkitt's lymphoma-associated antigen (BLA), P <sup>k</sup> blood group		B-sub, FDC, Endo	
CDw78	Ba, Leu-21		B, Macro	
CD79a	Ig- $\alpha$ , MB-1 (mouse), Ly-54 (mouse)	—	B	Co-receptor, signaling
CD79b	Ig- $\beta$ , B29 (mouse)			
CD80	B7, B7-1, BB1, Ly-58 (mouse)	CD28, CTLA-4	T-act, B-act, DC, Mono, Macro, LC	Signaling
CD81	Target of an anti-proliferative antibody-1 (TAPA-1)	Homotypic	Broad	Adhesion, signaling
CD82	GR15, R2.1A4, 4F9		Broad	
CD83	HB15		Interdigitating reticulum cells, LC, T-act, B-act	
CDw84	GR6		T-sub, B, NK, Mono, Pt	
CD85	GR4		B, Mono	
CD86	GR65		B, Mono	
CD87	Urokinase-type plasminogen activator receptor (u-PAR)	Urokinase-type plasminogen activator (u-PA)	Mono, Neutro, Eosino, Endo	Receptor

CD88	Complement component C5a receptor (C5aR), GR10	C5a	Mono, Macro, Neutro, Mast cells, Eosino	Complement receptor
CD89	Fc $\alpha$ R, IgA receptor	IgA	T-sub, B-sub, Mono, Macro, Neutro, Eosino	Receptor for IgA
CDw90	Thy-1, Theta, MRC OX7 (rat)		Human prothymocytes, mouse Thy, mouse T, mouse stem cells, mouse NK	Signaling, ? adhesion
CD91	$\alpha_2$ -macroglobulin-R, low density lipoprotein receptor-related protein (LRP)	Protease-antiprotease complexes, plasma lipoproteins	Mono, Macro	Receptor
CDw92	GR9		Broad	
CD93	GR11		Mono, Neutro, Endo	
CD94	Kp43		NK, T-sub	? Signaling
CD95	Fas, Apo-1		B-act, T-act	Apoptotic signaling
CD96	Tactile ('T-cell activation, increased late expression')		T-act, NK-act	? Adhesion, ? signaling
CD97	GR1, BL-KDD/F12		Broad	? Signaling
CD98	4F2, RL-388 (mouse)		T-act, B-act, NK-act, Mono, hematopoietic progenitors	
CD99	MIC2, E2, FMC29, 12E7, HuLy-m6		Thy, T, B, Mono	
CD100	BB18, A8, GR3		T, B-act, NK, Neutro, Mono, Pt	? Signaling
CDw101	BB27, BA27, GR14		T, NK, Mono, Neutro, Eosino, Endo	

Table 2. Continued

Antigen	Synonyms	Ligand(s)	Primary distribution	Function
CD102	ICAM-2	CD11a/CD18 (LFA-1)	Endo, T-sub, Mono, DC	Adhesion, co-stimulator for T cell activation
CD103	HML-1 $\alpha$ -chain, M290 (mouse)		Intra-epithelial T	Adhesion
CD104	Integrin $\beta^4$ subunit	Laminin?	Thy, Endo-sub	Adhesion
CD105	Endoglin, GR7, $\beta$ -glycan (rat)	TGF- $\beta$ 1, TGF- $\beta$ 3	BM-sub, Macro-act, Endo	Adhesion
CD106	VCAM-1, INCAM-110	Integrins $\alpha^4/\beta^1$ (CD49d/CD29, VLA-4) and $\alpha^4/\beta^7$	Endo-act, Macro, B, DC	Adhesion
CD107a CD107b	Lysosomal membrane glycoproteins-1 and 2 (LAMP-1 and LAMP-2)	CD62E	NK, Mono, B, Pt-act, Endo	Adhesion
CDw108	GR2		T, NK, B-act, Endo	Adhesion
CDw109	GR56, 8A3, 7D1		Mono, Pt, Endo	
CD115	Macrophage colony-stimulating factor receptor (M-CSFR), <i>c-fms</i> , CSF-1 receptor	M-CSF (CSF-1)	Macro, Mono and their precursors	Cytokine receptor, signaling
CDw116	Granulocyte macrophage colony-stimulating factor receptor (GM-CSFR), CSF-2R	GM-CSF	Macro, Mono, Neutro, Eosino and their precursors, Endo	Cytokine receptor, signaling
CD117	SLF/HGF-R, stem cell factor receptor, <i>c-kit</i>	Hematopoietic growth factor (HGF) / steel factor (SLF) / mast cell growth factor (MGF) / stem cell factor (SCF) / <i>kit</i> ligand (KL)	BM (most precursor cells), Thy, mast cells	Cytokine receptor, signaling

CDw119	Interferon $\gamma$ receptor (IFN $\gamma$ R)	IFN $\gamma$	Broad	Cytokine receptor, signaling
CD120a	Tumor necrosis factor receptor-I	TNF $\alpha$ , TNF $\beta$ (lymphotoxin)	Broad	Cytokine receptor, signaling
CD120b	Tumor necrosis factor receptor-II	TNF $\alpha$ , TNF $\beta$ (lymphotoxin)	Broad	Cytokine receptor, signaling
CDw121a	IL-1 receptor type I	IL-1 $\alpha$ , IL-1 $\beta$ , IL-1R antagonist	Thy, T, Endo	Cytokine receptor, signaling
CDw121b	IL-1 receptor type II	IL-1 $\alpha$ , IL-1 $\beta$ , IL-1R antagonist	B, Macro, Mono	
CD122	IL-2 receptor $\beta$ , p75	IL-2	T-act, NK	Cytokine receptor, signaling
CDw124	IL-4 receptor (IL-4R)	IL-4	T, B, Macro, Endo	Cytokine receptor, signaling
CD126	IL-6 receptor (IL-6R)	IL-6	Broad	Cytokine receptor, signaling
CDw127	IL-7 receptor (IL-7R)	IL-7	Thy, T, Pro-B, Pre-B, BM (lymphoid precursors), Mono	Cytokine receptor, signaling
CDw128	IL-8 receptor (IL-8R I, IL-8R II)	RI: IL-8. RII: IL-8, GRO $\alpha$ /MGSA, MIP-2, NAP-2	T-sub, Mono, Neutro, Baso	Cytokine receptor, signaling
CDw130	IL-6 receptor $\beta$ (IL-6R $\beta$ ), gp130-SIG	IL-6	Broad	Cytokine receptor, signaling
2B4			<b>Mouse</b> NK, T-act	Adhesion, ? signaling
4-1BB		Fibronectin, vitronectin, laminin, collagen VI	<b>Mouse</b> Thy, T-act	? Signaling
114-A10			<b>Mouse</b> myeloid progenitors	
A15			Immature T	

**Table 2.** Continued

<b>Antigen</b>	<b>Synonyms</b>	<b>Ligand(s)</b>	<b>Primary distribution</b>	<b>Function</b>
APA	Aminopeptidase A, gp160, 6C3 (mouse), BP-1 (mouse), Ly-51 (mouse)	Peptides	Early B, thymic cortical epith-sub, BM stroma, Endo	Metalloprotease
B7-2	B70, GL1	CD28, CTLA-4	Monocytes, dendritic cells, B-act, T-act, NK-act	Signaling
C-CAM	Cell-CAM105	Homophilic, calmodulin	Endo, Pt-act, Neutro, Mono	ATPase, adhesion
CD40L	CD40 ligand, TNF-related activation protein (TRAP), gp39, T-BAM	CD40	T-act (CD4 <sup>+</sup> )	Signaling
CLA	Cutaneous lymphocyte-associated antigen, HECA-452	CD62E	Skin memory T	Adhesion
CMRF35			T-sub, B-sub, Mono, Neutro	
CTLA-4	Ly-56 (mouse)	CD80, B7-2, B7-3	T-act	? Signaling, ? adhesion
EPO-R	Erythropoietin receptor	Erythropoietin	Erythroblasts	Cytokine receptor
FcεRI	High-affinity IgE receptor	IgE	Mast cells, Baso	Receptor for IgE, crosslinking leads to signaling for degranulation
flk-2	Fetal liver kinase-2		<b>Mouse</b> BM, immature Thy	? Signaling
fMLP-R	Formyl-Met-Leu-Phe receptor	fMet-Leu-Phe (f-MLP)	Mono, Neutro	Chemotaxis
G-CSFR	Granulocyte colony-stimulating factor receptor, CSF-3R	G-CSF	Granulocyte precursors, Neutro, Endo	Cytokine receptor, signaling

gp42				<b>Mouse</b> NK-act	
gp49				<b>Mouse</b> mast cells	
IgH $\kappa$ $\lambda$	B-cell antigen receptor, mIg	Antigen	B		Antigen receptor
IL-2R $\gamma$	IL-2 receptor $\gamma$ -chain	IL-2	T-act, B-act, Mono-act.		Cytokine receptor, signaling
IL-3R	IL-3 receptor	IL-3	BM (most precursor cells)		Cytokine receptor, signaling
IL-5R	IL-5 receptor	IL-5	Eosino, Baso, Mouse B		Cytokine receptor, signaling
IL-9R	IL-9 receptor	IL-9	Mast cells, Megakaryo, Thy, T-sub		Cytokine receptor, signaling
IL-10R	IL-10 receptor	IL-10	Macro, Mono, T, B, mast cells		Cytokine receptor, signaling
IL-11R	IL-11 receptor	IL-11	B, BM, Megakaryo		Cytokine receptor, signaling
IL-12R	IL-12 receptor	IL-12	T, NK		Cytokine receptor, signaling
IL-13R	IL-13 receptor	IL-13	Macro, Mono, B		Cytokine receptor, signaling
Integrin $\alpha^7$	H36	Mucosal vascular addressin, laminin	Mucosal lymphocytes, T-act		Adhesion
Integrin $\beta^7$	LPAM-1 $\beta$ -chain (with $\alpha^4$ [CDw49d]), HML-1 $\beta$ -chain, M290 $\beta$ -chain	MadCAM-1 (for $\alpha^4\beta^7$ integrin), VCAM-1, fibronectin	T-sub		Adhesion



Table 2. Continued

Antigen	Synonyms	Ligand(s)	Primary distribution	Function
LAG-3	Lymphocyte activation gene 3 product		T-act, NK-act	
LDL-R	Low-density lipoprotein receptor	LDL	T, B, Macro, Mono	Receptor
Leu-13			T, B, FDC, Endo	Signaling
LIF-R	Leukemia inhibitory factor receptor	LIF	Broad	Cytokine receptor
Itk	Leukocyte tyrosine kinase		B	Enzyme
Ly-9	T100		<b>Mouse</b> Thy, T, B, BM	
Ly-49	A1, YE1/48	MHC class I	<b>Mouse</b> Thy, T, NK-sub	Signaling
M6	Basigin, CE9, HT7, neurothelin, MRC OX-47 (rat)		Thy, T-act, Mono, Neutro, BM, Endo	? Signaling
M130	Ki-M8, Ber-Mac3, GHI/61, SM4		Macro, Mono	? Receptor
Mac-2	Carbohydrate-binding protein (CBP)-35 (mouse), L34 (mouse), RL-29 (mouse), HL-29 (mouse), HL-31 (mouse), IgE-binding protein (IgE-BP) (rat)	Galactose (e.g. on IgE, laminin, etc.)	Macro, DC, Neutro	Lectin
MAFA-G63	Mast-cell function-associated antigen-G63		<b>Rat</b> mast cells	Signaling
Mannose-R	Mannose receptor	Mannose	Macro	Adhesion for phagocytosis
M-ASGP-BP	Macrophage asialoglycoprotein binding protein	Gal/GalNAc-terminated glycoproteins	<b>Rat</b> Macro	Receptor
MDR1	Multidrug resistance-1, P-glycoprotein (P-gp)	Lipophilic molecules	BM, T-sub, Mono	

MHC I	HLA-A, B, C (human), H2-K, D, L (mouse), RT1A (rat)	Peptides, TCR, CD8	Most nucleated cells	Present Ag (usually endogenous) to TCR
MHC II	HLA-DP, DQ, DR (human), I-A, I-E (mouse), RT1B, RT1D (rat)	Peptides, TCR, CD4	B, Mono, Macro, DC, myeloid and erythroid precursors	Present Ag (usually exogenous) to TCR
MKW			Mono, B-sub	
MPL	<i>c-mpl, v-mpl</i>		? Broad at low level	? Receptor, signaling
MRC OX-2			B, rat Thy, rat FDC, rat Endo	
MRC OX-40			<b>Rat</b> T-act	
NB1			Neutro	
NK1.1	Member of NKR-P1 family	? Carbohydrate	<b>Mouse</b> Neutro, NK, Thy, T-sub	Signaling
NKG2		? Carbohydrate	NK, T-sub	? Receptor
PAF-R	Platelet-activating factor receptor	PAF	Eosino, Mono, Macro Neutro, Pt	Receptor
PC-1	Plasma cell antigen-1, Ly-41 (mouse)		T, PC	Enzyme with both nucleotide pyrophosphatase and alkaline phosphodiesterase-1 activities
R2	4F9, C33		T-sub, B-act	? Adhesion, ? signaling
RT6.1 6.2	ART-2, AgF, Pta		<b>Rat</b> T	

Table 2. Continued

Antigen	Synonyms	Ligand(s)	Primary distribution	Function
Sca-1	Stem cell antigen-1, TAP, MALA-1, DAG, Ly-6		<b>Mouse</b> Thy, T, B, BM, Neutro, Mono	? Signaling
Scav-R	Scavenger receptor	Polyanionic molecules	Macro, Endo	Receptor
SN8			B-sub	
Syndecan		Collagen, fibronectin, thrombospondin	Pre-B, immature B, PC (not found on mature B), Endo	Adhesion
TCR $\alpha$ TCR $\beta$	$\alpha\beta$ T-cell receptor, TCR-2	MHC-peptide	Thy, T-sub	Receptor for processed antigen
TCR $\gamma$ TCR $\delta$	$\gamma\delta$ T-cell receptor, TCR-1	MHC-peptide	Thy, T-sub	Receptor for processed antigen
TGF $\beta$ -R	Transforming growth factor receptors I-VI. $\beta$ -Glycan (TGF $\beta$ -RIII)	TGF $\beta$ family	Broad	Cytokine receptor, signaling
TSA-1	Thymic shared antigen-1		Cortical Thy, B, thymic medullary epith	

Abbreviations used: act, activated; B, B lymphocytes; Baso, basophils; BM, bone marrow hematopoietic progenitors; Cort Thy, cortical thymocytes; DC, dendritic cells; Eosino, eosinophils; Epith, epithelium; FDC, follicular dendritic cell; LC, Langerhan cells; Leuko, leukocytes; Macro, macrophages; mat, mature; Megakaryo, megakaryocytes; Mono, monocytes; Neutro, Neutrophils; NK, natural killer cells; PC, plasma cells; Pt, platelets; RBC, red blood cells; sub, subpopulation; T, T lymphocytes.

Where species differences occur these are noted.

**Mouse** or **rat** (bold) signifies molecule described in these species and human homolog not yet established.

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