An ECM Mimetic Library for Engineering Surfaces to Direct Cell Surface Receptor Binding Specificity and Signaling

The extracellular (ECM) microenvironment, defined by biochemical cues and physical cues, is a deciding factor in a wide range of cellular processes including cell adhesion, proliferation, differentiation, and expression of phenotype-specific functions. For this reason, engineering the ECM microenvironment provides clear benefits in studies of cell and tissue engineering and related applications. Currently existing technology offers simple and merely adequate environments that facilitate simple cell processes such as cellular adhesion.[1,2] The simple presentation of cell adhesion motifs is not optimal for controlling more integrated processes.

Crosstalk among signaling pathways act synergistically to enhance cellular responses such as cell adhesion or proliferation[3]. A recent study showed that a combination of extracellular matrix derived peptides presented on a surface may enhance cell adhesion strength and focal adhesion assembly. The combinatorial presentation of ECM peptides on cell growth surfaces may also promote elevated proliferation rates of primary or stem cells[4,5,6].

Kollodis BioSciences, Inc. provide a means to regulate a variety of cell surface receptors for your cell studies with the highlighted features provided below.

Advantageous Features uniquely offered by Kollodis BioSciences

- Offers a wide range of ECM derived peptide containing mussel adhesive proteins based casting to meet the needs of many cell culture systems
- Flexible engineering of biochemically defined surfaces to specifically direct your cell by manipulating your cell surface receptors
- Easy-to-use, *in situ* formable 3D MAPTrix HyGel™ matrix microenvironment
- Ensures consistently high-quality products with extensive quality control (QC) testing

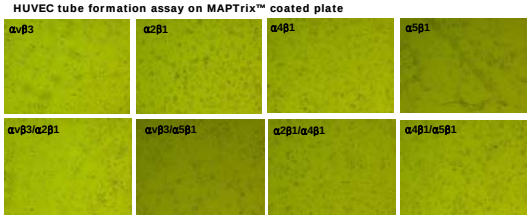
References

1. Samuel Schmidt, et al., Interstitial cell migration: integrin-dependent and alternative adhesion mechanisms. Cell Tissue Res (2010) 339:83–92
2. Stephanie J. Ellis, et al., Integrin-mediated adhesion and stem cell niche interactions. Cell Tissue Res (2010) 339 212-130
3. Sarah J. Fashena, et al., Signaling by adhesion receptors. Nature Cell Biology 2 E225-E229 (2000)
4. Reyes CD, et al., Mixed extracellular matrix ligands synergistically modulate integrin adhesion and signaling. J Cell Physiol. 2008 Nov;217(2):450-8.
5. Seung Tae Lee, et al., Engineering integrin signaling for promoting embryonic stem cell self-renewal in a precisely defined niche. Biomaterials 31 (2010) 1219–1226
6. Meng Y, et al., Characterization of integrin engagement during defined human embryonic stem cell culture. FASEB J. 2010 Apr;24(4):1056-65.

MAPTrix™ Technology: Your Solution for a Biochemically Defined ECM Microenvironment

Kollodis BioSciences' MAPTrix™ Technology provides a true ECM microenvironment by presenting combinatorial peptide motifs to induce and/or regulate combinatorial integrin mediated signaling for integrated cellular processes as demonstrated in endothelial tube formation on MAPTrix HyGel™ coated plates, as provided below.

HUVEC tube formation assay on MAPTrix™ coated plate



Integrin's role in endothelial tube formation was studied by culturing HUVEC cells on the artificial basement membrane matrix formed *in situ* from Kollodis' MAPTrix™ Angio Kit.

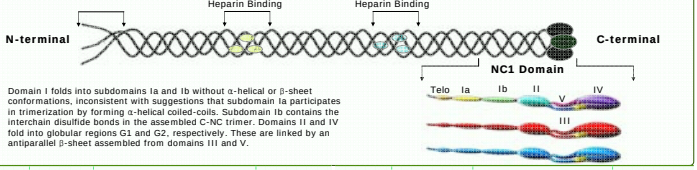
Artificial basement membranes that mimic endothelial basement membrane in terms of biochemical cues were created *in situ* from Kollodis' MAPTrix™ Angio Kit.

All the integrins studied were known to promote angiogenesis, but the MAPTrix™ ECM composition activating αvβ3 integrin provided a more favorable microenvironment for HUVEC tube formation. The αvβ3-α5β1 combination especially provided the best microenvironment for endothelial tube formation.

Collagen derived peptide

Collagens serve as scaffolds for the attachment of cells and matrix proteins; but, they are increasingly being recognized to have many other ligands and to be highly biologically active. For example, collagens provide integrin binding motifs and heparin binding motifs. The α2β1 integrin recognizes GXO/GER such as GFPGER or GFOGER, and these sites are for endothelial cell binding and activation, and for angiogenesis. Integrin binding sites for αvβ3 have antitumor activity, and may inhibit the activation of human neutrophil or the proliferation of capillary endothelial cells. Integrin binding sites in the NC1 domains have anti-angiogeneic properties mediated by the α1β1 or αvβ3 integrin binding.

Schematic diagram of the modular structure of collagen



Domain I folds into subdomains Ia and Ib without α-helical or β-sheet conformations, inconsistent with suggestions that subdomain Ia participates in trimerization by forming α-helical coiled-coils. Subdomain Ib contains the interchain disulfide bonds in the assembled C-NC trimer. Domains II and IV fold into globular regions G1 and G2, respectively. These are linked by an antiparallel β-sheet assembled from domains III and V.

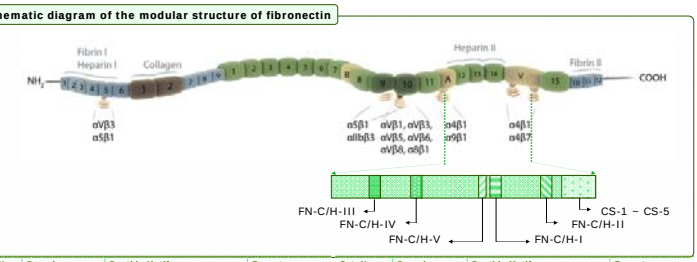
Cat. No.	Domain	Peptide Motif	Receptor
Collagen Type I & II derived peptide containing			
165011	α1(I) 7S	GLPGER	α1β1, α2β1
165021	α1(I)	KGHRGF	Heparin
165031	α1(I)	GDRGIKGHRGFSG	Heparin
165041	α1(I)	GFPGER	α1β1, α2β1
165051	α1(I) CBD	GLSGER	α2β1
165061	α1(I)	DGEA	α2β1
165071	α1(I)	GPAGKDGEAGAQG	α2β1
165081	α1(I)	GPKGAAGEPGKP	α1β1, α3β1
165091	α1(I)	GAPGPKGARGSA	α1β1, α3β1
165101	α1(I)	GDLGRPGRKGRPGPP	Heparin
165111	α1(I)	GHRGPTGRPGKRGKQGQKGDS	Heparin
165121	α1(I)	GTPGPQGIAGQRDVV	
165131	α1(I)	GPQGIAGQRGVVGLP	α1β1
165141	α1(I)	PKGQKGEKG	Poly(I)
165151	α1(I)	GASGER	α2β1
165161	α1(I)	GQRGER	α2β1
165171	α1(I)	GMPGER	
165181	α1(I)	GAPGER	
165191	α2(I)	KGIRGH	Heparin
165811	α1(III)	RGQPGVMGF	VWF
165821	α1(III)	GKDGES	α2β1
165831	α1(III)	GLKGEN	α2β1
165841	α1(III)	GLPGEN	α2β1
165851	α1(III)	GLPGEA	α2β1

Cat. No.	Domain	Peptide Motif	Receptor
Collagen Type IV derived peptide containing			
166211	α1(IV)Hep I	TAGSCLRKFSTM	α2β1, Heparin
166221	α1(IV)Hep II	LAGSCLARFSTM	α2β1, Heparin
166231	α1(IV)Hep III	GEFYFDLRLKGDK	α2β1, Heparin
166241	α1(IV)	GPPGDQGPPGIP	α1β1
166251	α1(IV)	GAKGRAGFPGLP	α1β1
166261	α1(IV)	MFKKPTPSTLKAGELR	
166271	α1(IV)	GFPGSRGDTGPP	
166281	α1(IV)	GVKGDKGNPGWPGAP	
166291	α1(IV)	FYFDLR	α1β1, α2β1
166301	α2(IV)	RGQPGVPGVPGMKGD	
166311	α3(IV)-NC1	TAIPSCPEGTVPLYS	
166321	α3(IV)-NC1	TDIPPCPHGWISLWK	
166331	α3(IV)-NC1	MNYYSNS	
166341	α3(IV)-NC1	CNYYSNSYSFWLASLNPER	
166351	α3(IV)-NC1	ISRCQVCMKKRH	α2β1
166361	α3(IV)-NC1	TLGSCLQRFTTM	
166371	α3(IV)-NC1	GRRGKT	
166381	α3(IV)	RGQPGRKGL	
166391	α3(IV)-NC1	MFRKPIPSTVKA	
166401	α3(IV)-NC1	IISRCQVCMKMRP	
166411	α4(IV)-NC1	LAGSCLPVFSTL	
166421	α5(IV)-NC1	TAGSCLRRFSTM	
166431	α5(IV)-NC1	GKRGKP	
166441	α5(IV)-NC1	NKRAHG	

Fibronectin derived peptide

Fibronectin naturally exists as a dimer, consisting of two nearly identical monomers. Two regions in each fibronectin subunit possess cell binding activity: III9-10 and III14-V (refer to the modular structure of fibronectin below). The primary receptor for adhesion to fibronectin commonly involves the RGD motif of repeat III10 through integrins such as α5β1; however, this integrin-ligand interaction is only sufficient for cell attachment and spreading. Additional signaling through the cell surface proteoglycan such as syndecan-4 is required for focal adhesion formation and rearrangement of the actin cytoskeleton into bundled stress fibers. This binding occurs primarily via the HepII domain (containing the FN type III repeats 12-14) in the C-terminal region of fibronectin.

Schematic diagram of the modular structure of fibronectin



Cat. No.	Domain	Peptide Motif	Receptor
161011	III-1	KYILRWRPKNS	Heparin
161021	III-5	WTPPRAQITGYRLTVGLTRR	α5β1
161031	III-5	KLDAPT	α4β1, α4β7
161041	III-9	PHSRN	α5β1
161051	III-10	RGD	α5β1, αvβ3
161061	III-10	RGDS	αIIbβ3
161071	III-10	GRGDSP	α5β1
161081	EDA	EDGIHEL	α4β1, α9β1
161091	III-13 (FN-C/H-III)	YRVRVTPKEKTGPMKE	Heparin
161101	III-13 (FN-C/H-IV)	SPPRRARVT	α5β1, Heparin
161111	III-13	ATETTITIS	Heparin
161121	III-13	VSPPRRARVTDATETTITISWRTKTETITGFG	α5β1, Heparin
161131	III-13	KPDVRSYTITG	α4β1, Heparin

Cat. No.	Domain	Peptide Motif	Receptor
161141	III-13	ANGQTPIQRYIK	α4β1, Heparin
161151	III-14	PRARITGYIIKYEKPGSPPREVVPRPRPGV	
161161	III-14 (FN-C/H-V)	WQPPRARI	SDC-4
161171	III-14 (FN-C/H-V)	WQPPRARITGYIIKYEKPG	SDC-4
161181	III-14 (FN-C/H-I)	YEKPGSPREVVPRPRPGV	Heparin
161191	III-14 (FN-C/H-II)	KNNQKSEPLIGRKKT	Heparin
161201	IIICS-1	EILDVPST	α4β1
161211	IIICS-1	IDAPS	α4β1
161221	IIICS-1	VVIDASTAIDAPSNL	α4β1
161231	IIICS-1	LDVPS	α4β1
161241	IIICS-5	REDV	α4β1
169251	III-10	PHSRN-RGDSP	α5β1

Additional ECM-derived peptides

Cadherins are calcium dependent cell adhesion proteins which are involved in many morphoregulatory processes including the establishment of tissue boundaries, tissue rearrangement, cell differentiation, and metastasis. The extracellular domain of E-cadherin tends to bind in a homophilic manner; however, heterophilic binding occurs under certain conditions. The binding of extracellular cadherin is the basis for cell-cell adhesion and tends to be prevalent at adherins junctions and is structurally associated with actin bundles.

Other sets of extracellular matrix components - for example, vitronectin, nidogen or Tenascin, and SIBLINGs (small integrin-binding ligand, N-linked glycoprotein) such as bone sialoprotein (BSP) or osteopontin derived ligand - can also influence the cellular behavior by regulating cell signaling (directly or indirectly). Unlike the main extracellular matrix components such as collagen or fibronectin, these other proteins are adhesion-modulatory extracellular matrix proteins which interact with the main ECM components or integrins.

Cat. No.	Domain	Peptide Motif
167011	EC1, groove	SHAVSS
167021	EC1, groove	LFSHAVSSNG
167031	EC1, bulge	ADTPPV
167041	EC1, bulge	QGADTPPVGV
167051	EC1	PLDREAIAKY
167061	EC1	DQNDN
167071		HAVDI
167081		LRAHAVDING
167091		LRAHAVDVNG (murine)

Cat. No.	Domain	Peptide Motif	Receptor
Vitronectin derived peptide			
168011	HVP	FRHRNRKGY	Heparin
168021	HVP	KKQRFRHRNRKGYRSQ	Heparin
168031	Somatomedin B	RGDV	αvβ3, αvβ5
168041	Somatomedin B	PQVTRGDVFTMP	αvβ3, αvβ5
Tenascin-C, Nidogen, Perlecan, Elastin derived peptide			
168111	Nidogen G2	LNRQELFPFG	
168121	Nidogen G2	SIGFRGDGQTC	
168211	Perlecan IV	TWSKVGGHLRPGIVQSG	IgB
168311	Tenascin-C	VAEIDGIEL	α9β1
168321	Tenascin-C	VFDNFVLK	α7β1
168511	Elastin	VGVAPG	
168521	Elastin	PGVGV	

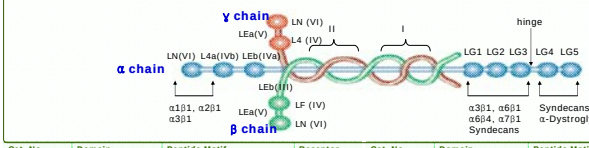
Cat. No.	Domain	Peptide Motif
167101	EC2	MKVSATDADD (murine)
167111	EC2	GLDRESYPYY (murine)
167121	EC2	VITVKDINDN (murine)
167131	EC2, bulge	QDPELPDKNM
167141	EC2, groove	LVVQAADLQG
167151	EC3, bulge	NDDGGQFVVT
167161	EC3, groove	YILHVAVTNY
167171	EC4, bulge	TYRIWRDTAN
167181	EC4, groove	YTALIIATDN

Cat. No.	Domain	Peptide Motif	Receptor
Other important peptide motif for cell culture			
169011	Bone sialoprotein	KRSR	Heparin
169021	Bone sialoprotein	FHRRIKA	Heparin, HSP
169311	CCN-1	TTSWSQCSKS	α6β1
169611	Osteopontin	SVVYGLR	α9β1
169621	Osteopontin	DGRGDSVAYG	αvβ3
169711	Thrombospondin	LALERKDHSG	α6β1
Fibrinogen derived peptide			
169511		RGDF	$\alpha_{IIb}\beta3$
169521		KRLDGSV	$\alpha_v\beta2$
169531		HHLGGAKQAGDV	$\alpha_{IIb}\beta3$
169541		YSMKKTTMKIIPFNRLTIG	$\alpha_{IIb}\beta3$
169551		GVYYQGGTYSKAS	$\alpha_v\beta2$

Laminin derived peptide (α1 ~ α5, β, γ chains)

Laminins, heterotrimers composed of α, β, and γ chains, are multifunctional glycoproteins present in basement membranes. Integrins, dystroglycan, syndecans, and several other cell surface molecules are cellular receptors for laminins. The globular domains located in the N- and C-terminus of the laminin alpha chains are critical for interactions with the cellular receptors. Integrin α6β1 binds to most of the laminin isoforms. Integrin α3β1 interacts with laminin-5 and -10/11 more specifically than the other isoforms. Integrins α1β1, α2β1, and α7β1 show binding activity to laminin-1 and -2. Interaction of integrin α6β4 with laminin-5 forms hemidesmosomes in the skin. α-dystroglycan strongly binds to the laminin α1 and α2 chains and moderately interacts with the α5 chain.

Schematic diagram of the modular structure of laminin



Cat. No.	Domain	Peptide Motif	Receptor
162011	α1 LN (A3)	LWVTVRSQQRGLF	α5β1
162021	α1 LN (A10)	GTNNWWQSPSIQN	α4β1, α4β7
162031	α1 LN (A12)	WVTVTLDLRQVFQ	α5β1
162041	α1 LN (A13)	RQVFQVAYIIIKA	α1β1, α2β1
162051	α1 LN (A18)	LTRYKITPRRGPPT	α5β1
162061	α1 LN (A24)	LLEFTSARYIRL	
162071	α1 LN (A25)	YIRLRLQRIRTL	
162081	α1 V? (A29)	RRYYYSIKDISV	
162091	α1 L4a (A51)	SINNTAVMQRLT	Heparin
162101	α1 L4a (A55)	GGFLKVTVSYDI	
162111	α1 L4a (A64)	RDQLMTVLANVT	
162121	α1 L4a (A65)	ANVTHLLIRANY	Heparin
162131	α1 L4a (A99)	AGTFALRGDNPQG	
162141	α1 L4a (A112)	VLIKGGRARKHV	α5β1
162151	α1 L4a (A119)	LSNIDYILIKAS	SDC-4
162161	α1 L4a (A121)	LQQSRIANISME	SDC-4
162171	α1 L1 (A167)	NLLLLLVKANLK	
162181	α1 L1 (A174)	HRDELLLWARKI	
162191	α1 L1 (A177)	KRRARDLVHRAE	
162201	α1 L1 (A191)	SQFQESVDNITK	
162211	α1 L1 (A194)	PGGMREKGRKAR	
162221	α1 L1 (A203)	MEMQANLLLDRL	
162231	α1 L1 (A206)	LSEIKLLISRAR	
162241	α1 L1 (A208)	IKVAV	αvβ3
162251	α1 L1 (A208)	AASIKVAVSADR	αvβ3
162261	α1 LG1 (AG10)	NRWHSIYITRFG	α6β1
162271	α1 LG2 (AG22)	SSFHFDGSGYAM	
162281	α1 LG2 (AG32)	IAFQRN	α6β1
162291	α1 LG2 (AG32)	TWYKIAFQRNRK	α6β1
162301	α1 LG2 (AG56)	SLVRNRRVITIQ	
162311	α1 LG4 (AG73)	LQVQLSIR	SDC-1, -4
162321	α1 LG4 (AG73)	RKRLQVQLSIRT	SDC-1, -4
162331	α1 LG4 (AG75)	GLIYYVAHQNQM	SDC-1, -4
162341	EF-1	DYATLQLQEGRLHFMFDLG	α2β1
162411	α2 LG (A2G2)	KKGSYNNIVVHV	
162421	α2 LG (A2G4)	ADNLLFYLGSAK	
162431	α2 LG (A2G5)	GSAKFIDFLAIE	
162441	α2 LG (A2G7)	KVSFLWWVGSGV	
162451	α2 LG (A2G10)	SYWYRIEASRTG	
162461	α2 LG (A2G25)	ISTVMFKFRTFS	
162471	α2 LG (A2G34)	KQANISIVDIDSN	
162481	α2 LG (A2G48)	FSTRNESGIILL	
162491	α2 LG (A2G51)	RRQTTQAYYAIF	
162501	α2 LG (A2G52)	YAIFLNKGRLEV	
162511	α2 LG (A2G76)	KNRLTIELEVRT	
162521	α2 LG (A2G78)	GLLFYMARINHA	
162531	α2 LG (A2G80)	VQLRNGFPYFSY	
162541	α2 LG (A2G84)	HKIKIVRVKQEG	
162551	EF-2	DFGTVQLRNGFPFFSYDLG	
162561	α2 LG (A2G94)	YFDGTGFAKAVG	
162571	α2 LG (A2G103)	NGQWHKVTAKKI	
162581	α2 LG (A2G104)	AKKIKNRLELVV	
162591	α2 LG (A2G109)	GFPGGLNQPGLTTN	
162601	α2 LG (A2G110)	NQPGLTTNIRFRG	
162611	α2 LG (A2G111)	IRSLKLTKGTGKP	
162621	α2 LG (A2G113)	AKALELRGVQPVS	
162811	α3 (A3-10)	GQLFHVAYILIKF	
162821	α3 LG (MA3G13)	SQRIYQFAKLNYT	
162831	α3 LG (MA3G22)	NVLSLYNKTTF	

Cat. No.	Domain	Peptide Motif	Receptor
162841	α3 LG (MA3G27)	NAPFPKLSWTIQ	
162851	α3 LG (MA3G28)	WTIQTTVDRGLL	
162861	α3 LG (MA3G34)	DTINNGRDHMILI	
162871	α3 LG (MA3G35)	MILSIGKSQKRM	
162881	α3 LG (A3GXX)	PPFLMLLKGSTR (human)	
162891	α3 LG (MA3G57)	NQRLASFSNAQQS	
162901	α3 LG (MA3G59)	ISNVFVQRMSQSPEVLD	
162911	α3 LG (MA3G63)	KARSFNVNQLLQD	
162921	α3 LG A3G75	KNSFMALYLSKG	
162931	α3 LG A3G756	KNSFMALYLSKGRLVFALG	
162941	EF-3	RDSFVALYLSEGHVIFALG	
162951	α3 LG MA3G70	KPRLQFSLDIQT	
162961	α3 LG MA3G97	DGQWHSVTVSIK	
163211	α4 LG (A4G4)	FVLYLGSKNAKK	
163221	α4 LG (A4G6)	LAIKNDNLVYVY	
163231	α4 LG (A4G10)	AYFSIVKIERVG	
163241	α4 LG (A4G20)	DVISLYNFKHIY	
163251	α4 LG (A4G24)	FFDGSSYAVVRD	
163261	α4 LG (A4G31)	LHVFYDFGFSNG	
163271		LKKAQINDAKYREISIIYHN	
163281	α4 LG (A4G47)	RAYFNGQSFIAS	
163291	α4 LG (A4G59)	SRLRGKNPTKGK	
163301	α4 LG (A4G69)	LHKKGKNSSKPK	
163311		RLKTRSSHGMIF	
163321	α4 LG (A4G78)	GEKSQFSIRLKT	
163331	α4 LG (A4G82)	TLFLAHGRLVFM	
163341	α4 LG (A4G83)	LVFMFNVGHKKL	
163351	α4 LG (A4G823)	TLFLAHGRLVFMFNVGHKKL	
163361	EF-4	DFMTLFLAHGRLVFMFNVG	
163371	α4 LG (A4G84)	HKKLKIRSQEKY	
163381	α4 LG (A4G90)	GAAWKIKGPIYL	
163391	α4 LG (A4G107)	VIRDSNVVQLDV	
163611	α5 LN (S1)	EVNVTLDLGQVFH	α5β1
163621	α5 LN (S2)	GQVFHVAYVLIKF	α4β1, α4β7
163631	α5 LN (S6)	RDFTKATNIRLRFLR	α5β1
163641	α5 LN (S7)	NIRLRFLRTNTL	α5β1
163651	α5 LG1 (A5G3)	GKNTGDHFVLYM	α5β1
163661	α5 LG1 (A5G19)	VVSLYNFEQTFML	
163671	α5 LG2 (A5G26)	RFDQELRLVSYN	
163681	α5 LG2 (A5G27)	RLVSYSGVLFFLK	Heparin
163691	α5 LG2 (A5G)	GIIFFL	Heparin
163701	α5 LG2 (A5G33)	ASKAIQVFLLGG	
163711	α5 LG2 (A5G35)	VLVRVERATVFS	Heparin
163721	α5 LG2 (A5G36)	TVFSVDQDNMLE	
163731	α5 LG3 (A5G63)	RLRGPQRVFDLH	α5β1
163741	α5 LG3 (A5G64)	FDLHQNMGSVN	SDC-4
163751	α5 LG3 (A5G65)	QQNLGSVNVSTG	SDC-4
163761	α5 LG3 (A5G66)	SRATAQKVSRRS	
163771	α5 LG4 (A5G71)	GSLSSHLEFVGI	
163781	α5 LG4 (A5G73)	RNRLHLSMLVRP	
163791	α5 LG4 (A5G76)	APMSGRSPSLVLK	
163801	α5 LG4 (A5G77)	LALFLSNGHFVA	
163811	α5 LG4 (A5G81)	PGRWHKVSVRWE	
163821	α5 LG4 (A5G82)	VRWGMQQIQLVV	
163831	α5 LG5 (A5G94)	KMPYVSLELEMR	
163841	α5 LG5 (A5G99)	VLLQANDGAGEF	
163851	α5 LG5 (A5G101)	DGRWHRVAVIMG	
163861	α5 LG5 (A5G109)	APVNVTASVQIQ	
163871	α5 LG5 (A5G112)	KQGKALTQRHAK	

Cat. No.	Domain	Peptide Motif	Receptor
164011	VI (B-7)	AFGVLALWGTRV	
164021	VI (B-15)	IENVVTTFAPNR	
164031	VI (B-19)	LEAEFHFTHLIM	
164041	VI (B-20)	HLIMTFKTFRPA	
164051	VI (B-23)	KTWGVYRYFAYD	
164061	VI (B-30)	RIQNLLKITNLRIKFVK	Heparin
164071	VI (B-31)	TNLRIKFVKLHT	
164081	VI (B-34)	REKYYYAVYDMV	
164091	V (B-54)	KRLVTGQR	
164101	IV (B-62)	GPGVVVVERQYI	Heparin
164111	IV (B-73)	RYVVLPR	Heparin
164121	IV (B-77)	SPYTFIDSLVLMPY	
164131	III (B-96)	PDSGR	
164141	III (B-98)	YIGSR	α1β1, α3β1
164151	III (B-98)	DPGYIGSR	α1β1, α3β1
164161	(B-116)	FALWDAIIGEL	
164171	II (B-123)	AAEPLKNIGILF	
164181	II (B-133)	DSITKYFQMSLE	
164191	I (B-160)	VILQQSAADIAR	
164201	I (B-187)	KDISEKVAVYST	
164211		LGTIPG	

Cat. No.	Domain	Peptide Motif	Receptor
164411	VI (C-3)	LWPLLAVLAAVA	
164421	VI (C-16)	KAFDITYVRLKF	αvβ3, α5β1
164431	VI (C-25)	AFSTLEGRPSAY	
164441	VI (C-28)	TDIRVTLNRLNTF	
164451	VI (C-30)	NEPKVLKSYYYAI	
164461	VI (C-31)	YYAISDFAVGGR	
164471	VI (C-35)	LPFFNDRPWRRAT	
164481	V (C-38)	FDPELYRSTGHGGH	
164491	V (C-50)	TNAVGYSVYDIS	
164501	IV (C-57)	APVKFLGNQVLSY	
164511	IV (C-59)	SFSFRVDRRDTR	
164521	IV (C-64)	SETTVKYIFRLHE	
164531	IV (C-67)	FQKLLNNLTSIK	
164541	IV (C-68)	TSIKIRGTYSER	
164551	III (C75)	DPETGV	
164561	II (C102)	KEAEREVTDLLR	
164571	II (C-118)	TSAEAYNLLLRT	
164581	(C-121)	LNRRYEQARNIS	
164591	(C-155)	SLLSQLNNLLDQ	
164601		RNIAEIIKDI	
164611		RDIAEIIKDI	

Product Availability:

- Red Highlighted Catalog Numbers: Product in stock
- Non-Red Highlighted Catalog Numbers: Product provided on-demand (typically 4-6 weeks)

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