

Supplemental Table 1 SP1-RV

Ligand	Receptor	Ligand rank	Receptor rank	Interaction rank
Mfap2	Notch1	56	157	1
Dlk1	Notch1	64	157	2
Mfap5	Notch1	66	157	3
Fgf2	Fgfr1	409	26	4
Ncam1	Fgfr1	531	26	5
Efna5	Epha4	533	113	6
Ntf5	Ngfr	534	175	7
Fgf2	Sdc1	409	329	8
App	Ngfr	650	175	9
Lpl	Sdc1	522	329	10
Nid1	Col13a1	712	158	11
Cthrc1	Fzd3	523	380	12
Fgf2	Fgfr1	409	495	13
Adam17	Notch1	790	157	14
Inha	Acvr2b	713	281	15
App	Gpc1	650	712	16
Ntn1	Unc5c	1	1383	17
Fgf2	Fgfr2	409	1003	18
Lama4	Itga6	26	1394	19
Ntn1	Unc5b	1	1437	20
Efnb1	Epha4	1359	113	21
Ncam1	Fgfr2	531	1003	22
Efna5	Epha7	533	1044	23
Dlk1	Notch2	64	1618	24
Rspo3	Lgr4	3	1708	25
Ecm1	Cachd1	140	1599	26
Lamc1	Itga6	349	1394	27
Psap	Celsr1	1311	472	28
Col6a1	Itga6	443	1394	29
Efna5	Ephb1	533	1571	30
Fgf9	Fgfr1	2224	26	31
Lrpap1	Sor1	390	1996	32
Lama4	Itga3	26	2445	33
Wnt5a	Fzd4	758	1769	34
Rspo3	Lgr6	3	2551	35
Col5a2	Ddr1	138	2425	36
Nid2	Col13a1	2419	158	37
Col1a1	Ddr1	210	2425	38
Tgfb3	Tgfb1	17	2619	39
Rein	Itga3	196	2445	40
Wnt5a	Ryk	758	1954	41
Ncam1	Robo1	531	2214	42
Fn1	Col13a1	2611	158	43
Lamc1	Itga3	349	2445	44
Efnb1	Ephb1	1359	1571	45
Igf2	Igf1r	199	2769	46
Igf1	Igf1r	358	2769	47
Nid1	Itga3	712	2445	48
Thbs1	Sdc1	2834	329	49
Col11a1	Ddr1	742	2425	50
Rspo3	Sdc4	3	3185	51
Hgf	Sdc1	2892	329	52
Fgf18	Fgfr1	3198	26	53
Apoe	Sor1	1228	1996	54
Fgf9	Fgfr2	2224	1003	55
App	Slc45a3	650	2593	56
Tfpi	Sdc4	62	3185	57
Ntn1	Neo1	1	3329	58
Lrpap1	Ldlr	390	2949	59
Col3a1	Ddr1	990	2425	60
Gm11808	Notch1	3293	157	61
Dlk1	Notch4	64	3487	62
Fgf2	Sdc4	409	3185	63
Tgfb2	Tgfb1	996	2619	64
Lrpap1	Lrp2	390	3305	65
Rarres2	Gpr1	444	3262	66
B2m	Tfrc	2338	1399	67
Lama5	Sdc1	3446	329	68
Lamb1	Itga6	2411	1394	69
Apoe	Scarb1	1228	2581	70
Lpl	Lrp2	522	3305	71
Gdnf	Gfra1	343	3510	72
Tgm2	Sdc4	670	3185	73
Timp2	Itga3	1435	2445	74
Thbs2	Itga6	2491	1394	75
Rgma	Neo1	560	3329	76
Hspg2	Col13a1	3760	158	77
Il2	Ngfr	3746	175	78
Myoc	Fzd3	3613	380	79
Fn1	Itga6	2611	1394	80
Ncam1	Gfra1	531	3510	81
Lamc1	Itgb4	349	3720	82
Hspg2	Sdc1	3760	329	83
Myoc	Fzd10	3613	486	84
Sfrp1	Fzd6	36	4071	85
Efna4	Epha4	3996	113	86
Wnt5a	Fzd7	758	3385	87
Nid1	Ptprf	712	3463	88
Apoe	Ldlr	1228	2949	89
Fgf18	Fgfr2	3198	1003	90
Thbs1	Itga6	2834	1394	91
Dll4	Notch1	4152	157	92
Rspo3	Fzd8	3	4361	93
Tfpi	F3	62	4372	94
Apoe	Lrp2	1228	3305	95
Cthrc1	Fzd6	523	4071	96
Rtn4	Ngfr	4503	175	97
Nrtn	Gfra1	1241	3510	98
Wnt5a	Fzd6	758	4071	99
Efna3	Epha4	4717	113	100

Supplemental Table 1 SP1-UB

Ligand	Receptor	Ligand rank	Receptor rank	Interaction rank
Tfpi	Vldlr	62	29	1
Ntn1	Neo1	1	215	2
Reln	Vldlr	196	29	3
Rspo3	Lgr5	3	298	4
Gdnf	Gfra1	343	2	5
Gdnf	Ret	343	3	6
Lrpap1	Vldlr	390	29	7
Ncam1	Gfra1	531	2	8
Fgf2	Fgfr2	409	137	9
Lpl	Vldlr	522	29	10
Ncam1	Fgfr2	531	137	11
Rgma	Bmpr1b	560	130	12
Rgma	Neo1	560	215	13
Nid1	Ptprf	712	352	14
Ntn1	Unc5b	1	1104	15
Nrtn	Gfra1	1241	2	16
Nrtn	Ret	1241	3	17
Apoe	Vldlr	1228	29	18
Rspo3	Sdc4	3	1432	19
Igf2	Igf1r	199	1258	20
Dcn	Met	446	1018	21
Tfpi	Sdc4	62	1432	22
Igf1	Igf1r	358	1258	23
Lrpap1	Sort1	390	1356	24
Efna5	Ephb2	533	1248	25
Fgf2	Sdc4	409	1432	26
Efna5	Epha4	533	1380	27
Wnt5a	Fzd4	758	1222	28
Lama4	Itga6	26	1961	29
Tgm2	Sdc4	670	1432	30
Tbc1d24	Neo1	1989	215	31
Ltbp3	Itgb5	489	1810	32
Lamc1	Itga6	349	1961	33
Fgf9	Fgfr2	2224	137	34
Efnb1	Erbp2	1359	1009	35
App	Slc45a3	650	1721	36
Col6a1	Itga6	443	1961	37
Cthrc1	Fzd3	523	1947	38
Tfpi	F3	62	2452	39
Vegfb	Ret	2511	3	40
Btc	Erbp2	1555	1009	41
Efnb1	Ephb2	1359	1248	42
Psap	Sort1	1311	1356	43
Cntn4	Ptprg	377	2348	44
Efnb1	Epha4	1359	1380	45
Efna5	Epha1	533	2389	46
Mfap2	Notch1	56	2893	47
Dlk1	Notch1	64	2893	48
Mfap5	Notch1	66	2893	49
Fgf2	Fgfr1	409	2614	50
Hgf	St14	2892	255	51
Apoe	Scarb1	1228	2071	52
Rspo3	Lrp6	3	3312	53
Fgf18	Fgfr2	3198	137	54
Btc	Erbp3	1555	1843	55
Gm11808	Bmpr1b	3293	130	56
Cicf1	Crif1	3589	10	57
Adam17	Notch1	790	2893	58
Wnt5a	Ror1	758	3115	59
Hgf	Met	2892	1018	60
Lama4	Itga3	26	3958	61
Reln	Itga3	196	3958	62
Inha	Acvr2a	713	3452	63
Lama5	Bcam	3446	772	64
Thbs1	Sdc4	2834	1432	65
Lamc1	Itgb4	349	3929	66
Gm11808	Erbp2	3293	1009	67
Lamc1	Itga3	349	3958	68
Lamb1	Itga6	2411	1961	69
Gnai2	Adora1	4185	214	70
Dcn	Erbp4	446	3994	71
Dkk2	Lrp6	1132	3312	72
Thbs2	Itga6	2491	1961	73
Rspo1	Lgr5	4273	298	74
Fn1	Itga6	2611	1961	75
Ltbp1	Itgb5	2782	1810	76
Ntn1	Unc5c	1	4592	77
App	Gpc1	650	3959	78
Nid1	Itga3	712	3958	79
Wnt5a	Ryk	758	3918	80
Wnt5a	Lrp5	758	3923	81
Lrpap1	Sorl1	390	4292	82
Igfbp4	Lrp6	1415	3312	83
Sfrp1	Fzd6	36	4716	84
Adam17	Erbp4	790	3994	85
Thbs1	Itga6	2834	1961	86
Fgf2	Sdc1	409	4403	87
Myoc	Fzd4	3613	1222	88
Clec11a	Kit	153	4751	89
Thbs1	Scarb1	2834	2071	90
Lpl	Sdc1	522	4403	91
Tgfb3	Tgfb1	17	4970	92
Apoe	Lrp5	1228	3923	93
Efna5	Ephb6	533	4629	94
Fbn1	Itgb6	858	4308	95
Cthrc1	Fzd6	523	4716	96
Ndp	Fzd4	4032	1222	97
Gnai2	Unc5b	4185	1104	98
Fgf7	Fgfr2	5191	137	99
Efna4	Epha4	3996	1380	100

Supplemental Table 1 SP2-RV

Ligand	Receptor	Ligand rank	Receptor rank	Interaction rank
Gdnf	Gfra1	11	42	1
Rspo3	Lgr5	493	87	2
Dkk1	Lrp6	1	670	3
Dkk2	Lrp6	143	670	4
Reln	Vldlr	35	941	5
Rspo3	Lrp6	493	670	6
Rspo3	Fzd8	493	778	7
Fgf2	Sdc1	353	953	8
Dlk1	Notch1	149	1182	9
Fgf2	Fgfr4	353	1016	10
Fgf2	Fgfr1	353	1211	11
Mfap2	Notch1	411	1182	12
Efna2	Epha4	1615	15	13
Gdf11	Acvr2b	752	887	14
Sema3a	Plxna4	217	1457	15
Fgf2	Gpc4	353	1359	16
Efna3	Epha4	1710	15	17
Nid1	Ptprf	1216	568	18
Lama4	Itga6	1599	188	19
Rspo3	Lgr4	493	1322	20
Slit2	Robo1	1772	56	21
Fn1	Itga6	1677	188	22
Cxcl12	Sdc4	90	1887	23
Efna2	Epha7	1615	409	24
Efna3	Epha7	1710	409	25
Gm11808	Notch1	965	1182	26
Efna4	Epha4	2184	15	27
Fgf2	Sdc4	353	1887	28
Igfbp4	Lrp6	1633	670	29
Col6a1	Itga6	2165	188	30
Rspo3	Sdc4	493	1887	31
Cxcl12	Cxcr4	90	2292	32
Igfbp4	Fzd8	1633	778	33
Efna4	Epha7	2184	409	34
Hgf	St14	1795	883	35
Slit2	Sdc1	1772	953	36
Fgf2	Fgfr2	353	2386	37
Hgf	Sdc1	1795	953	38
Gnai2	Adra2a	743	2153	39
Efnb3	Epha4	2929	15	40
Dkk1	Lrp5	1	2948	41
Dkk1	Notch3	149	2806	42
Lama2	Itga6	2775	188	43
Efna2	Epha1	1615	1433	44
Sema6a	Plxna4	1619	1457	45
Cntn4	Ptprg	702	2382	46
Tfpi	Vldlr	2179	941	47
Efna3	Epha1	1710	1433	48
Gm11808	Bmpr1b	965	2234	49
Fgf2	Fgfr1	353	2857	50
Ntn1	Unc5b	211	3030	51
Gnai2	Adora1	743	2531	52
Col5a2	Ddr1	526	2830	53
Wnt5a	Fzd4	2830	532	54
Col11a1	Ddr1	557	2830	55
Efnb3	Ephb3	2929	505	56
Hgf	Met	1795	1677	57
Reln	Itga3	35	3453	58
Gnai2	Igf1r	743	2775	59
Wnt5a	Fzd8	2830	778	60
Efna4	Epha1	2184	1433	61
Gnai2	Unc5b	743	3030	62
Tnc	Sdc1	2907	953	63
Col3a1	Ddr1	1055	2830	64
Col5a2	Itga1	526	3428	65
Col1a1	Ddr1	1140	2830	66
Col8a1	F11r	2047	1954	67
Tfpi	Sdc4	2179	1887	68
Col4a4	Itga1	747	3428	69
Fgf11	Fgfr4	3248	1016	70
Dcn	ErbB4	3861	412	71
Sema3a	Nrp1	217	4131	72
Fgf11	Fgfr1	3248	1211	73
Fgf2	Nrp1	353	4131	74
Col1a1	Itga1	1140	3428	75
Col1a2	Itga1	1202	3428	76
Nid1	Itga3	1216	3453	77
Thbs2	Itga6	4504	188	78
Wnt5a	Ryk	2830	1931	79
Tnc	Sdc4	2907	1887	80
Ngf	Sort1	1125	3680	81
Tnfrsf12	Tnfrsf12a	2450	2403	82
Efna5	Epha4	4997	15	83
Lama4	Itga3	1599	3453	84
Efna3	Ephb1	1710	3386	85
Fn1	Itga3	1677	3453	86
Col5a1	Itga1	1743	3428	87
Col6a3	Itga1	1751	3428	88
Gm11808	ErbB2	965	4262	89
Adm	Ramp2	1475	3867	90
Mfap5	Notch1	4182	1182	91
Dll3	Notch1	4222	1182	92
Efna5	Epha7	4997	409	93
Bmp4	Acvr2b	4533	887	94
Dusp18	Itga6	5237	188	95
Slit2	Gpc1	1772	3654	96
Dcn	Met	3861	1677	97
Col6a2	Itga1	2153	3428	98
Col6a1	Itga1	2165	3428	99
				100

Supplemental Table 1 SP2-UB

Ligand	Receptor	Ligand rank	Receptor rank	Interaction rank
Gdnf	Gfra1	11	2	1
Gdnf	Ret	11	3	2
Reln	Vldlr	35	29	3
Ntn1	Neo1	211	215	4
Fgf2	Fgfr2	353	137	5
Rspo3	Lgr5	493	298	6
Gnai2	Adora1	743	214	7
Cxcl12	Ackr3	90	920	8
Gm11808	Bmpr1b	965	130	9
Ntn1	Unc5b	211	1104	10
Cxcl12	Sdc4	90	1432	11
Nid1	Ptprf	1216	352	12
Vegfb	Ret	1671	3	13
Fgf2	Sdc4	353	1432	14
Gnai2	Unc5b	743	1104	15
Rspo3	Sdc4	493	1432	16
Gm11808	ErbB2	965	1009	17
Gnai2	Igf1r	743	1258	18
Hgf	St14	1795	255	19
Tfpi	Vldlr	2179	29	20
Cxcl12	Cxcr4	90	2294	21
Ngf	Sort1	1125	1356	22
Tbc1d24	Neo1	2496	215	23
Hgf	Met	1795	1018	24
Fgf2	Fgfr1	353	2614	25
Ngf	Maged1	1125	1863	26
Efna2	Epha4	1615	1380	27
Dlk1	Notch1	149	2893	28
Cntn4	Ptprg	702	2348	29
Efna3	Epha4	1710	1380	30
Mfap2	Notch1	411	2893	31
Dkk1	Lrp6	1	3312	32
a	F11r	2047	1329	33
Fgf11	Fgfr2	3248	137	34
Dkk2	Lrp6	143	3312	35
Lama4	Itga6	1599	1961	36
Efna4	Epha4	2184	1380	37
Tfpi	Sdc4	2179	1432	38
Fn1	Itga6	1677	1961	39
Rspo3	Lrp6	493	3312	40
C1qtnf1	Avpr2	2152	1671	41
Gm11808	Notch1	965	2893	42
Rgma	Bmpr1b	3740	130	43
Edil3	Itgb5	2081	1810	44
Dkk1	Lrp5	1	3923	45
Rgma	Neo1	3740	215	46
Reln	Itga3	35	3958	47
Efna2	Epha1	1615	2389	48
Wnt5a	Fzd4	2830	1222	49
Efna3	Epha1	1710	2389	50
Col6a1	Itga6	2165	1961	51
Efnb3	Ephb2	2929	1248	52
Gdf11	Acvr2a	752	3452	53
Efnb3	Epha4	2929	1380	54
Tnc	Sdc4	2907	1432	55
Sema3a	Plxna3	217	4314	56
Efna4	Epha1	2184	2389	57
Tfpi	F3	2179	2452	58
Igf2	Igf1r	3381	1258	59
Bmp4	Bmpr1b	4533	130	60
Lama2	Itga6	2775	1961	61
Fgf2	Sdc1	353	4403	62
Ntn1	Unc5c	211	4592	63
Sema3a	Plxna1	217	4622	64
Dcn	Met	3861	1018	65
Igfbp4	Lrp6	1633	3312	66
Fn1	Cd79a	1677	3334	67
Tnc	Ptprz1	2907	2170	68
Nid1	Itga3	1216	3958	69
Tgfb3	Tgfb1	238	4970	70
Ltbp3	Itgb5	3458	1810	71
Fgf13	Scn8a	5451	63	72
Igf1	Igf1r	4288	1258	73
Lama4	Itga3	1599	3958	74
Fgf13	Fgfr2	5451	137	75
Fn1	Itga3	1677	3958	76
Nts	Sort1	4296	1356	77
Fbn1	Itgb6	1363	4308	78
Tgfb2	Tgfb1	746	4970	79
Fgf2	Fgfr4	353	5365	80
Slit2	Gpc1	1772	3959	81
Sfrp1	Fzd6	1036	4716	82
Vcam1	Itga4	682	5129	83
Gm11808	Tgfb1	965	4970	84
Wnt5a	Ror1	2830	3115	85
Sema3a	Nrp1	217	5741	86
Itgb3bp	Itgb5	4172	1810	87
Fn1	Itgb6	1677	4308	88
Efnb3	Rhbdl2	2929	3092	89
App	Slc45a3	4360	1721	90
Fgf2	Nrp1	353	5741	91
Slit2	Sdc1	1772	4403	92
Hgf	Sdc1	1795	4403	93
Efna5	Ephb2	4997	1248	94
Col5a2	Ddr1	526	5760	95
Col11a1	Ddr1	557	5760	96
Efna3	Ephb6	1710	4629	97
Efna5	Epha4	4997	1380	98
Thbs2	Itga6	4504	1961	99
Tgfb3	Eng	238	6245	100

Supplemental Table 1 SP3-RV

Ligand	Receptor	Ligand rank	Receptor rank	Interaction rank
Gdnf	Gfra1	1	42	1
Rspo3	Lgr5	21	87	2
Lama4	Itga6	200	188	3
Efna5	Epha4	389	15	4
Efna3	Epha4	480	15	5
Efna4	Epha4	610	15	6
Rspo3	Lrp6	21	670	7
Efna5	Epha7	389	409	8
Rspo3	Fzd8	21	778	9
Dkk1	Lrp6	182	670	10
Efna3	Epha7	480	409	11
Reln	Vldlr	15	941	12
Hgf	St14	122	883	13
Fgf2	Sdc1	62	953	14
Efna4	Epha7	610	409	15
Hgf	Sdc1	122	953	16
Fgf2	Fgfr4	62	1016	17
Fn1	Itga6	965	188	18
Fgf2	Fgfr1	62	1211	19
Mfap2	Notch1	144	1182	20
Rspo3	Lgr4	21	1322	21
Fgf2	Gpc4	62	1359	22
Dlk1	Notch1	322	1182	23
Gm11808	Notch1	394	1182	24
Tfpi	Vldlr	746	941	25
Hgf	Met	122	1677	26
Efna5	Epha1	389	1433	27
Rspo3	Sdc4	21	1887	28
Efna3	Epha1	480	1433	29
Fgf2	Sdc4	62	1887	30
Efna4	Epha1	610	1433	31
Cxcl12	Sdc4	191	1887	32
Sema6a	Plxna4	623	1457	33
Sema3a	Plxna4	678	1457	34
Dkk2	Lrp6	1487	670	35
Fgf2	Fgfr2	62	2386	36
Cxcl12	Cxcr4	191	2292	37
Gm11808	Bmpr1b	394	2234	38
Tfpi	Sdc4	746	1887	39
Rgma	Bmpr1b	472	2234	40
a	F11r	847	1954	41
Fgf2	Fgfr1	62	2857	42
Fgf13	Scn8a	2407	565	43
Ntn1	Unc5b	20	3030	44
Dlk1	Notch3	322	2806	45
Dkk1	Lrp5	182	2948	46
Bmp5	Acvr2b	2263	887	47
Col11a1	Ddr1	339	2830	48
Fgf13	Fgfr4	2407	1016	49
Igf2	Igf1r	655	2775	50
Wnt5a	Fzd4	2916	532	51
Reln	Itga3	15	3453	52
Col4a4	Itga1	73	3428	53
Col1a1	Ddr1	679	2830	54
Nrtn	Gfra1	3492	42	55
Col8a1	Itga1	123	3428	56
Efnb1	Epha4	3587	15	57
Fgf13	Fgfr1	2407	1211	58
Lama4	Itga3	200	3453	59
Wnt5a	Fzd8	2916	778	60
Cntn4	Ptpqg	1330	2382	61
Efna5	Ephb1	389	3386	62
Efna3	Ephb1	480	3386	63
Col5a2	Ddr1	1184	2830	64
Tnfrsf12	Tnfrsf12a	1624	2403	65
Efnb1	Ephb3	3587	505	66
Col1a1	Itga1	679	3428	67
Col4a3	Itga1	721	3428	68
Efna5	Ephb2	389	3777	69
Fgf2	Nrp1	62	4131	70
Col3a1	Ddr1	1386	2830	71
Efnb3	Epha4	4330	15	72
Efna2	Epha4	4350	15	73
Nid1	Ptpf	3848	568	74
Tfpi	F3	746	3671	75
Fn1	Itga3	965	3453	76
Bmp5	Bmpr1b	2263	2234	77
Col5a2	Itga1	1184	3428	78
Gm11808	Erb2	394	4262	79
Gnai2	Adra2a	2594	2153	80
Efna2	Epha7	4350	409	81
a	Mgm1	847	3929	82
Fgf13	Fgfr2	2407	2386	83
Sema3a	Nrp1	678	4131	84
Efnb3	Ephb3	4330	505	85
Wnt5a	Ryk	2916	1931	86
Igfbp4	Lrp6	4241	670	87
Col1a2	Itga1	1518	3428	88
Sema3d	Nrp1	823	4131	89
Col6a1	Itga6	4629	188	90
Igfbp4	Fzd8	4241	778	91
Dusp18	Itga6	4891	188	92
Gnai2	Adora1	2594	2531	93
Col6a3	Itga1	1818	3428	94
Fgf11	Fgfr4	4322	1016	95
Gnai2	Igf1r	2594	2775	96
Lamc1	Itga6	5223	188	97
Penk	Oprk1	406	5117	98
Fgf11	Fgfr1	4322	1211	99
Gnai2	Unc5b	2594	3030	100

Supplemental Table 1 SP3-UB

Ligand	Receptor	Ligand rank	Receptor rank	Interaction rank
Gdnf	Gfra1	1	2	1
Gdnf	Ret	1	3	2
Reln	Vldlr	15	29	3
Fgf2	Fgfr2	62	137	4
Ntn1	Neo1	20	215	5
Rspo3	Lgr5	21	298	6
Hgf	St14	122	255	7
Gm11808	Bmpr1b	394	130	8
Rgma	Bmpr1b	472	130	9
Rgma	Neo1	472	215	10
Tfpi	Vldlr	746	29	11
Cxcl12	Ackr3	191	920	12
Ntn1	Unc5b	20	1104	13
Hgf	Met	122	1018	14
Gm11808	ErbB2	394	1009	15
Rspo3	Sdc4	21	1432	16
Fgf2	Sdc4	62	1432	17
Cxcl12	Sdc4	191	1432	18
Efna5	Ephb2	389	1248	19
Efna5	Epha4	389	1380	20
Efna3	Epha4	480	1380	21
Igf2	Igf1r	655	1258	22
Efna4	Epha4	610	1380	23
Lama4	Itga6	200	1961	24
a	F11r	847	1329	25
Tfpi	Sdc4	746	1432	26
Bmp5	Bmpr1b	2263	130	27
Fgf13	Scn8a	2407	63	28
Cxcl12	Cxcr4	191	2294	29
Fgf13	Fgfr2	2407	137	30
Fgf2	Fgfr1	62	2614	31
Efna5	Epha1	389	2389	32
Gnai2	Adora1	2594	214	33
Vegfb	Ret	2842	3	34
Efna3	Epha1	480	2389	35
Tbc1d24	Neo1	2676	215	36
Fn1	Itga6	965	1961	37
Efna4	Epha1	610	2389	38
Ltbp3	Itgb5	1203	1810	39
Mfap2	Notch1	144	2893	40
Tfpi	F3	746	2452	41
Dkk1	Notch1	322	2893	42
Gm11808	Notch1	394	2893	43
Rspo3	Lrp6	21	3312	44
Nrtn	Gfra1	3492	2	45
Dkk1	Lrp6	182	3312	46
Nrtn	Ret	3492	3	47
Cntn4	Ptprg	1330	2348	48
Gnai2	Unc5b	2594	1104	49
Gnai2	Igf1r	2594	1258	50
Reln	Itga3	15	3958	51
Ngf	Sort1	2635	1356	52
Dkk1	Lrp5	182	3923	53
Wnt5a	Fzd4	2916	1222	54
Lama4	Itga3	200	3958	55
Nid1	Ptprf	3848	352	56
Fn1	Cd79a	965	3334	57
C1qtnf1	Avpr2	2636	1671	58
Fgf11	Fgfr2	4322	137	59
Fgf2	Sdc1	62	4403	60
Ngf	Maged1	2635	1863	61
Hgf	Sdc1	122	4403	62
Efnb1	ErbB2	3587	1009	63
Ntn1	Unc5c	20	4592	64
Dkk2	Lrp6	1487	3312	65
Edil3	Itgb5	2995	1810	66
Efnb1	Ephb2	3587	1248	67
Bmp5	Bmpr1a	2263	2644	68
Fn1	Itga3	965	3958	69
Efnb1	Epha4	3587	1380	70
Sema3a	Plxna3	678	4314	71
Efna5	Ephb6	389	4629	72
Sfrp1	Fzd6	341	4716	73
Tgfb3	Tgfb1	87	4970	74
Efna3	Ephb6	480	4629	75
Fn1	Itgb6	965	4308	76
Sema3a	Plxna1	678	4622	77
Tgfb2	Tgfb1	386	4970	78
Gm11808	Tgfb1	394	4970	79
Fgf2	Fgfr4	62	5365	80
Efnb3	Ephb2	4330	1248	81
Tgm2	Sdc4	4146	1432	82
Efnb3	Epha4	4330	1380	83
Bmp5	Acvr2a	2263	3452	84
Efna2	Epha4	4350	1380	85
Fgf2	Nrp1	62	5741	86
App	Sloc45a3	4276	1721	87
Wnt5a	Ror1	2916	3115	88
Fn1	Itga4	965	5129	89
Col11a1	Ddr1	339	5760	90
Lpl	Vldlr	6115	29	91
Tgfb3	Eng	87	6245	92
Sema3a	Nrp1	678	5741	93
Col1a1	Ddr1	679	5760	94
Fbn1	Itgb6	2154	4308	95
Sema3d	Nrp1	823	5741	96
Tgfb2	Eng	386	6245	97
Efna2	Epha1	4350	2389	98
Col6a1	Itga6	4829	1961	99
Wnt5a	Ryk	2916	3918	100

Supplemental Table 1 RV-SP1

Ligand	Receptor	Ligand rank	Receptor rank	Interaction rank
Npy	Fap	8	16	1
Wnt4	Fzd2	9	70	2
Pdgfa	Pdgfra	29	89	3
Bmp4	Bmpr1a	345	203	4
Efnb1	Ephb2	446	168	5
Vcan	Egfr	280	379	6
Ncam1	Ptptra	215	605	7
Bmp2	Bmpr1a	802	203	8
Plat	Lrp1	593	545	9
Rspo1	Fzd8	151	1107	10
Rspo1	Lrp6	151	1188	11
Tgfa	Egfr	1041	379	12
Lama1	Itgb8	1135	372	13
Vegfa	Ephb2	1362	168	14
Ntf3	Ntrk2	1535	122	15
Bmp7	Bmpr1a	1472	203	16
Efnb2	Ephb2	1520	168	17
Bmp4	Acvr1	345	1347	18
Vegfa	Egfr	1362	379	19
Lpl	Lrp1	1525	545	20
Lama1	Sdc2	1135	986	21
Bmp2	Acvr1	802	1347	22
Vcan	Itgb1	280	2281	23
Lama4	Itgb1	312	2281	24
Lamc1	Itgb1	327	2281	25
Bmp7	Acvr1	1472	1347	26
Lpl	Sdc1	1525	1316	27
Col4a1	Itgb8	2644	372	28
Gnai2	Egfr	2696	379	29
BC055324	Plscr4	2071	1070	30
Col2a1	Itgb1	891	2281	31
Pdgfa	Pdgfrb	29	3165	32
Vtn	Tnfrsf11b	3061	251	33
Lamb1	Itgb1	1034	2281	34
Nppc	Npr3	1719	1603	35
Hras	Sdc2	2346	986	36
Vegfa	Itga9	1362	2006	37
Slit3	Robo2	1956	1427	38
Lamc1	Itga1	327	3084	39
Lama1	Itgb1	1135	2281	40
Col2a1	Itga2b	891	2530	41
Gm11808	Egfr	3043	379	42
Lama4	Itgav	312	3116	43
Vtn	Itgb8	3061	372	44
Lamc1	Itgav	327	3116	45
Gdf5	Bmpr1a	3296	203	46
Gnai2	Tbxa2r	2696	841	47
Tac2	Tacr3	1499	2122	48
Gnai2	Agt2	2696	928	49
Hras	Cav1	2346	1294	50
Vegfa	Itgb1	1362	2281	51
Lamc2	Cd151	2453	1269	52
Prss23	Tmem222	1048	2805	53
Col4a1	Cd47	2644	1260	54
Col2a1	Itga1	891	3084	55
Gnai2	Cav1	2696	1294	56
Sema3f	Nrp1	748	3252	57
L1cam	Ephb2	3935	168	58
Lamb1	Itga1	1034	3084	59
Gdf5	Ror2	3296	825	60
Timp2	Itgb1	1841	2281	61
Cdh1	Egfr	3752	379	62
Lamb1	Itgav	1034	3116	63
Lama1	Itga1	1135	3084	64
Sost	Lrp6	3095	1188	65
L1cam	Egfr	3935	379	66
Rgmb	Neo1	3588	726	67
Vtn	Cd47	3061	1260	68
Cdh1	Cdh2	3752	585	69
Adam10	Axl	3668	707	70
Gm11808	Acvr1	3043	1347	71
Slit2	Sdc1	3090	1316	72
Vegfa	Itgav	1362	3116	73
Npy	Npy2r	8	4478	74
Slit2	Robo2	3090	1427	75
Efnb1	Ephb3	446	4130	76
Col18a1	Gpc4	3600	992	77
Vegfa	Nrp1	1362	3252	78
Gdf5	Acvr1	3296	1347	79
Sema4c	Plxn2	3580	1101	80
Lamc2	Itgb1	2453	2281	81
Vegfc	Itga9	2908	2006	82
Col4a1	Itgb1	2644	2281	83
Efnb1	Ephb4	446	4581	84
Mfge8	Itgav	2059	3116	85
Vegfc	Itgb1	2908	2281	86
Efnb5	Ephb2	5025	168	87
Gnai2	S1pr3	2696	2500	88
Mfge8	Pdgfrb	2059	3165	89
Pdgfc	Pdgfra	5137	89	90
Lama1	Gpc1	1135	4138	91
Serpina1a	Lrp1	4787	545	92
Vtn	Itgb1	3061	2281	93
Vegfa	Kdr	1362	3991	94
Lama5	Sdc1	4093	1316	95
Npnt	Itgb1	3150	2281	96
Fbln1	Itgb1	3199	2281	97
Vegfa	Gpc1	1362	4138	98
Lama1	Nt5e	1135	4371	99
C1cf1	Il6st	1341	4172	100

Supplemental Table 1 RV-SP2

Ligand	Receptor	Ligand rank	Receptor rank	Interaction rank
Pdgfa	Pdgfrb	29	23	1
Pdgfa	Pdgfra	29	756	2
Sema3f	Nrp1	748	215	3
Ncam1	Fgfr1	215	888	4
Npy	Fap	8	1236	5
Vegfa	Itga9	1362	130	6
Lamc1	Itga1	327	1225	7
Vegfa	Nrp1	1362	215	8
Vcan	Egfr	280	1299	9
Jag1	Notch3	94	1521	10
Fgf8	Fgfr1	977	888	11
Fgf15	Fgfr1	1023	888	12
Mfge8	Pdgfrb	2059	23	13
Dil1	Notch3	583	1521	14
Col2a1	Itga1	891	1225	15
Ncam1	Robo1	215	1934	16
Lama1	Itgb8	1135	1100	17
Lamb1	Itga1	1034	1225	18
Bmp2	Eng	802	1503	19
Tgfa	Egfr	1041	1299	20
Lama1	Itga1	1135	1225	21
Ncam1	Cacna1c	215	2215	22
Vcan	Itgb1	280	2286	23
Lama4	Itgb1	312	2286	24
Lamc1	Itgb1	327	2286	25
Jag1	Notch1	94	2535	26
Wnt4	Fzd2	9	2644	27
Vegfa	Egfr	1362	1299	28
Bmp4	Bmpr1a	345	2345	29
Bmp4	Acvr1	345	2361	30
Gnai2	F2r	2696	59	31
Gnai2	S1pr3	2696	106	32
Plat	Lrp1	593	2219	33
Cicf1	Cntfr	1341	1550	34
Gnai2	Ednra	2696	208	35
Bmp7	Eng	1472	1503	36
Vegfc	Itga9	2908	130	37
Gnai2	Agtr2	2696	385	38
Prss23	Tmem222	1048	2058	39
Dil1	Notch1	583	2535	40
Bmp2	Bmpr1a	802	2345	41
Bmp2	Acvr1	802	2361	42
Col2a1	Itgb1	891	2286	43
Ltbp1	Itgb5	462	2719	44
Lamb1	Itgb1	1034	2286	45
Lama1	Itgb1	1135	2286	46
Vtn	Itga8	3061	521	47
Vegfa	Itgb1	1362	2286	48
Npnt	Itga8	3150	521	49
Col4a1	Itgb8	2644	1100	50
Lpl	Lrp1	1525	2219	51
Bmp7	Bmpr1a	1472	2345	52
Bmp4	Acvr2a	345	3481	53
Bmp7	Acvr1	1472	2361	54
Col4a1	Itga1	2644	1225	55
Slit3	Robo2	1956	1917	56
Itgb3bp	Itgb5	1180	2719	57
Gnai2	Egfr	2696	1299	58
Lama4	Itgav	312	3688	59
Lamc1	Itgav	327	3688	60
Fgf9	Fgfr1	3166	888	61
Bmp4	Bmpr2	345	3711	62
Edn1	Ednra	3859	208	63
Gdf5	Ror2	3296	786	64
Timp2	Itgb1	1841	2286	65
Vtn	Itgb8	3061	1100	66
Cicf1	Il6st	1341	2891	67
Gnai2	Ptpnu	2696	1583	68
Bmp2	Acvr2a	802	3481	69
Gm11808	Egfr	3043	1299	70
Nppc	Npr3	1719	2743	71
Adam10	Axl	3668	824	72
Bmp2	Bmpr2	802	3711	73
Jag1	Notch4	94	4507	74
Lamb1	Itgav	1034	3688	75
Lamc2	Itgb1	2453	2286	76
Hras	Agtr1a	2346	2400	77
Col4a1	Itgb1	2644	2286	78
Bmp7	Acvr2a	1472	3481	79
Slit2	Robo2	3090	1917	80
Slit2	Robo1	3090	1934	81
Vegfa	Itgav	1362	3688	82
Cdh1	Egfr	3752	1299	83
Adam15	Itga9	4927	130	84
Nppc	Npr2	1719	3339	85
Dil1	Notch4	583	4507	86
Ntf3	Ntrk2	1535	3569	87
Pdgfc	Pdgfrb	5137	23	88
Bmp7	Bmpr2	1472	3711	89
Lpl	Sdc1	1525	3661	90
Sema3f	Plxna3	748	4444	91
Vegfc	Itgb1	2908	2286	92
L1cam	Egfr	3935	1299	93
Vtn	Itgb1	3061	2286	94
Sema3f	Plxna1	748	4650	95
Gm11808	Acvr1	3043	2361	96
Npnt	Itgb1	3150	2286	97
Ncam1	Ptpna	215	5221	98
Gm11808	Agtr1a	3043	2400	99
Fbln1	Itgb1	3199	2286	100

Supplemental Table 1 RV-SP3

Ligand	Receptor	Ligand rank	Receptor rank	Interaction rank
Npy	Fap	8	363	1
Pdgfa	Pdgfra	29	424	2
Ncam1	Robo1	215	311	3
Vcan	Egfr	280	439	4
Ncam1	Fgfr1	215	513	5
Wnt4	Fzd2	9	1160	6
Lama1	Itgb8	1135	113	7
Pdgfa	Pdgfrb	29	1304	8
Efna4	Epha7	784	597	9
Tgfa	Egfr	1041	439	10
Fgf8	Fgfr1	977	513	11
Fgf15	Fgfr1	1023	513	12
Bmp4	Bmpr1a	345	1247	13
Vegfa	Itga9	1362	245	14
Vegfa	Egfr	1362	439	15
Bmp2	Bmpr1a	802	1247	16
Sema3f	Nrp1	748	1661	17
Ntf3	Ntrk2	1535	882	18
Slit2	Robo2	1956	537	19
Ncam1	Cacna1c	215	2376	20
Efnb1	Ephb2	446	2153	21
Bmp7	Bmpr1a	1472	1247	22
Col4a1	Itgb8	2644	113	23
Gnai2	F2r	2696	217	24
Vegfa	Nrp1	1362	1661	25
Efna1	Epha7	2447	597	26
Gnai2	Egfr	2696	439	27
Vegfc	Itga9	2908	245	28
Vtn	Itgb8	3061	113	29
Ncam1	Ptpn11	215	2986	30
Tac2	Tacr3	1499	1835	31
Vtn	Tnfrsf11b	3061	292	32
Mfge8	Pdgfrb	2059	1304	33
Bmp2	Eng	802	2586	34
Slit2	Robo1	3090	311	35
Gnai2	Aqtr2	2696	710	36
Cicf1	Cntfr	1341	2119	37
Gm11808	Egfr	3043	439	38
Vegfa	Ephb2	1362	2153	39
Efna2	Epha7	2978	597	40
Bmp4	Acvr1	345	3234	41
Gnai2	Ptpn11	2696	894	42
Slit2	Robo2	3090	537	43
Efnb2	Ephb2	1520	2153	44
Fgf9	Fgfr1	3166	513	45
Sema3f	Plxn1	748	3162	46
Plat	Lrp1	593	3426	47
Bmp2	Acvr1	802	3234	48
Bmp7	Eng	1472	2586	49
Efnb1	Ephb3	446	3684	50
Sema3f	Plxn3	748	3409	51
Ncam1	Gfra1	215	3947	52
Cdh1	Egfr	3752	439	53
Prss23	Tmem222	1048	3148	54
Gnai2	S1pr3	2696	1647	55
Gdf5	Ror2	3296	1064	56
L1cam	Egfr	3935	439	57
Efnb1	Ephb4	446	3962	58
Jag1	Notch2	94	4420	59
Gdf5	Bmpr1a	3296	1247	60
Lpl	Sdc1	1525	3092	61
Bmp7	Acvr1	1472	3234	62
Clec11a	Kit	2642	2151	63
Lpl	Lrp1	1525	3426	64
Dll1	Notch2	583	4420	65
Adam10	Axl	3668	1500	66
Adam15	Itga9	4927	245	67
Jag1	Notch1	94	5097	68
Efnb2	Ephb3	1520	3684	69
Cdh1	Cdh2	3752	1499	70
Col2a1	Itga2b	891	4457	71
Vcan	Itgb1	280	5139	72
Rspo1	Fzd8	151	5270	73
Lama4	Itgb1	312	5139	74
Lamc1	Itgb1	327	5139	75
Efnb2	Ephb4	1520	3962	76
Bmp4	Bmpr2	345	5145	77
Pdgfc	Pdgfra	5137	424	78
Fgf16	Fgfr1	5097	513	79
Efna5	Epha7	5025	597	80
Dll1	Notch1	583	5097	81
Jag1	Notch4	94	5833	82
Bmp2	Bmpr2	802	5145	83
Fgf10	Fgfr1	5465	513	84
Col2a1	Itgb1	891	5139	85
Sema4a	Plxnd1	4449	1618	86
L1cam	Ephb2	3935	2153	87
Lamb1	Itgb1	1034	5139	88
Ltbp1	Itgb5	462	5717	89
Slit2	Sdc1	3090	3092	90
Lama1	Itgb1	1135	5139	91
Gm11808	Acvr1	3043	3234	92
Nppc	Npr2	1719	4618	93
Tgfa	ErbB4	1041	5315	94
Rspo1	Lrp6	151	6225	95
Dll1	Notch4	583	5833	96
Pdgfc	Pdgfrb	5137	1304	97
Nppc	Npr3	1719	4756	98
Vegfa	Itgb1	1362	5139	99
Gdf5	Acvr1	3296	3234	100

Supplemental Table 1 RV-UB

Ligand	Receptor	Ligand rank	Receptor rank	Interaction rank
Ncam1	Gfra1	215	2	1
Ncam1	Fgfr2	215	137	2
Rspo1	Lgr5	151	298	3
Bmp4	Bmpr1b	345	130	4
Bmp2	Bmpr1b	802	130	5
Fgf8	Fgfr2	977	137	6
Fgf15	Fgfr2	1023	137	7
Cicf1	Crif1	1341	10	8
Vegfa	Ret	1362	3	9
Efnb1	Erb2	446	1009	10
Lpl	Vldlr	1525	29	11
Bmp7	Bmpr1b	1472	130	12
Pcsk9	Vldlr	1583	29	13
Efnb1	Ephb2	446	1248	14
Efnb1	Epha4	446	1380	15
Rspo1	Znrf3	151	1829	16
Tgfa	Erb2	1041	1009	17
Efna4	Epha4	784	1380	18
Ltbp1	Itgb5	462	1810	19
Lama4	Itga6	312	1961	20
Lamc1	Itga6	327	1961	21
Lama1	Sdc4	1135	1432	22
Vegfa	Ephb2	1362	1248	23
Rspo4	Lgr5	2366	298	24
Efnb2	Ephb2	1520	1248	25
Tgfa	Erb2	1041	1843	26
Efnb2	Epha4	1520	1380	27
Gnai2	Adora1	2696	214	28
Jag1	Notch1	94	2893	29
Bmp4	Bmpr1a	345	2644	30
Itgb3bp	Itgb5	1180	1810	31
Lamb1	Itga6	1034	1961	32
Lama1	Itga6	1135	1961	33
Gm11808	Bmpr1b	3043	130	34
Efna4	Epha1	784	2389	35
Fgf9	Fgfr2	3166	137	36
Gdf5	Bmpr1b	3296	130	37
Bmp2	Bmpr1a	802	2644	38
Rspo1	Lrp6	151	3312	39
Dll1	Notch1	583	2893	40
Rgmb	Bmpr1b	3588	130	41
Bmp4	Acvr2a	345	3452	42
Gnai2	Unc5b	2696	1104	43
Rgmb	Neo1	3588	215	44
Efna1	Epha4	2447	1380	45
Sema5a	Met	2866	1018	46
Gnai2	Igf1r	2696	1258	47
Gm11808	Erb2	3043	1009	48
L1cam	Fgfr2	3935	137	49
Spint1	St14	3848	255	50
Cdh1	Ptprf	3752	352	51
Bmp7	Bmpr1a	1472	2644	52
Igf2	Igf1r	2986	1258	53
Bmp2	Acvr2a	802	3452	54
Lamc1	Itgb4	327	3929	55
Lama4	Itga3	312	3958	56
Lamc1	Itga3	327	3958	57
Efna2	Epha4	2978	1380	58
Lamc2	Itga6	2453	1961	59
Efnb2	Rhbdl2	1520	3092	60
Wnt4	Fzd6	9	4716	61
Lamc2	Cd151	2453	2277	62
Efna1	Epha1	2447	2389	63
Lama5	Bcam	4093	772	64
Vtn	Itgb5	3061	1810	65
Bmp7	Acvr2a	1472	3452	66
Col2a1	Itga10	891	4048	67
L1cam	Erb2	3935	1009	68
Aggrn	Lrp4	2597	2356	69
Lamb1	Itgb4	1034	3929	70
Lamb1	Itga3	1034	3958	71
Cdh1	Igf1r	3752	1258	72
Tgfa	Erb2	1041	3994	73
Sema3f	Plxna3	748	4314	74
Lama1	Itgb4	1135	3929	75
Efnb1	Ephb6	446	4629	76
Lama1	Itga3	1135	3958	77
Lama1	Gpc1	1135	3959	78
L1cam	Ephb2	3935	1248	79
Fgf16	Fgfr2	5097	137	80
Vegfa	Gpc1	1362	3959	81
Efna2	Epha1	2978	2389	82
Sema3f	Plxna1	748	4622	83
Efnb1	Ephb3	446	4939	84
Vcan	Itga4	280	5129	85
Lamc3	Itga6	3462	1961	86
Vegfa	Sirpa	1362	4078	87
Prss23	Tmem222	1048	4396	88
Cdh1	Erb2	3752	1843	89
Fgf10	Fgfr2	5465	137	90
Cthrc1	Fzd3	3806	1947	91
L1cam	Erb2	3935	1843	92
Timp2	Itga3	1841	3958	93
Lpl	Sdc1	1525	4403	94
Gm11808	Notch1	3043	2893	95
Gdf5	Bmpr1a	3296	2644	96
Npy	Npy2r	8	6038	97
Lama5	Itga6	4093	1961	98
Sema4d	Erb2	5069	1009	99
Sema4d	Met	5069	1018	100

Supplemental Table 1 UB-SP1

Ligand	Receptor	Ligand rank	Receptor rank	Interaction rank
Nrtn	Gfra2	17	124	1
Bmp7	Bmpr1a	59	203	2
Cdh1	Egfr	261	379	3
Btc	Egfr	322	379	4
Cdh1	Cdh2	261	585	5
L1cam	Ephb2	705	168	6
Npy	Fap	1017	16	7
L1cam	Egfr	705	379	8
Wnt11	Fzd7	41	1080	9
Bmp7	Acvr1	59	1347	10
Lamc2	Cd151	172	1269	11
Slit2	Sdc1	139	1316	12
Slit2	Robo2	139	1427	13
Pdgfc	Pdgfra	1664	89	14
Sema6a	Plxna2	92	1959	15
Efnb2	Ephb2	2019	168	16
Lama5	Sdc1	1057	1316	17
Lamc2	Itgb1	172	2281	18
Col18a1	Gpc4	1610	992	19
Npnt	Itgb1	338	2281	20
Cgn	F11r	2929	295	21
Lama5	Itgb1	1057	2281	22
Pdgfa	Pdgfra	3390	89	23
Hspg2	Ptprs	2912	764	24
Lamc1	Itgb1	1441	2281	25
L1cam	Itgav	705	3116	26
Col18a1	Itgb1	1610	2281	27
Bmp8b	Bmpr1a	3723	203	28
Lamb1	Itgb1	1668	2281	29
Sema3d	Nrp1	749	3252	30
Sema3c	Nrp1	771	3252	31
BC055324	Plscr4	2963	1070	32
Hspg2	Sdc1	2912	1316	33
Shh	Boc	4144	114	34
Slit2	Gpc1	139	4138	35
Col4a1	Itgb8	3909	372	36
Sema3f	Nrp1	1051	3252	37
Gm11808	Egfr	3949	379	38
Shh	Cdon	4144	217	39
Prss23	Tmem222	1609	2805	40
Lamc1	Itga1	1441	3084	41
Ctf1	Il6st	379	4172	42
Lamc1	Itgav	1441	3116	43
Lamb1	Itga1	1668	3084	44
Lamb1	Itgav	1668	3116	45
Shh	Smo	4144	681	46
Pdgfc	Pdgfrb	1664	3165	47
Serpine2	Lrp1	4321	545	48
Tac1	Tacr3	2816	2122	49
App	Lrp1	4431	545	50
Bmp8b	Acvr1	3723	1347	51
Col4a1	Cd47	3909	1260	52
Ihh	Boc	5074	114	53
Hspg2	Itgb1	2912	2281	54
Sema4d	Plxnb2	4111	1101	55
Ihh	Cdon	5074	217	56
Gm11808	Acvr1	3949	1347	57
Shh	Hhip	4144	1195	58
Bcan	Egfr	5100	379	59
Npy	Npy2r	1017	4478	60
Col9a3	Mag	38	5458	61
Efna5	Ephb2	5351	168	62
Gdf5	Bmpr1a	5373	203	63
Lama1	Itgb8	5217	372	64
Col18a1	Kdr	1610	3991	65
Pdgfc	Kdr	1664	3991	66
App	Cav1	4431	1294	67
Col18a1	Gpc1	1610	4138	68
Efna4	Epha5	53	5735	69
Wnt5a	Fzd2	5788	70	70
Tgfa	Egfr	5582	379	71
Btc	ErbB2	322	5746	72
Efnb2	Ephb3	2019	4130	73
Col4a1	Itgb1	3909	2281	74
Gdf5	Ror2	5373	825	75
Lama1	Sdc2	5217	986	76
Wnt4	Fzd2	6163	70	77
Cgn	Tgfb2	2929	3323	78
1700013F07Rik	Plscr4	5189	1070	79
Ihh	Hhip	5074	1195	80
Sema3c	Nrp2	771	5501	81
Serpinc1	Lrp1	5752	545	82
Lamc2	Itga3	172	6141	83
Vegfa	Ephb2	6167	168	84
L1cam	ErbB2	705	5746	85
Bmp3	Bmpr1a	6286	203	86
Col9a1	Mag	1031	5458	87
Vegfa	Egfr	6167	379	88
Sema3f	Nrp2	1051	5501	89
Pdgfa	Pdgfrb	3390	3165	90
Efnb2	Ephb4	2019	4581	91
Shh	Ptch2	4144	2457	92
Wnt5a	Ror2	5788	825	93
Il11	Gm13305	6455	162	94
Anxa1	Egfr	6255	379	95
Lamb3	Cd151	5432	1269	96
Gdf5	Acvr1	5373	1347	97
Serpinc1	Sdc2	5752	986	98
Lrpap1	Lrp1	6231	545	99
Dusp18	Cd151	5562	1269	100

Supplemental Table 1 UB-SP2

Ligand	Receptor	Ligand rank	Receptor rank	Interaction rank
Kitl	Epor	114	378	1
Npnt	Itga8	338	521	2
Sema3d	Nrp1	749	215	3
Sema3c	Nrp1	771	215	4
Sema3f	Nrp1	1051	215	5
Cdh1	Egfr	261	1299	6
Bmp7	Eng	59	1503	7
Btc	Egfr	322	1299	8
Pdgfc	Pdgfrb	1664	23	9
L1cam	Egfr	705	1299	10
Fgf9	Fgfr1	1118	888	11
Wnt11	Fzd7	41	1999	12
Slit2	Robo2	139	1917	13
Slit2	Robo1	139	1934	14
Npy	Fap	1017	1236	15
Bmp7	Bmpr1a	59	2345	16
Bmp7	Acvr1	59	2361	17
Pdgfc	Pdgfra	1664	756	18
Lamc2	Itgb1	172	2286	19
Npnt	Itgb1	338	2286	20
Lamc1	Itga1	1441	1225	21
Fgf12	Fgfr1	1951	888	22
Lamb1	Itga1	1668	1225	23
Ctf1	Il6st	379	2891	24
Jag1	Notch3	1811	1521	25
Lama5	Itgb1	1057	2286	26
Sema3c	Plxnd1	771	2573	27
Pdgfa	Pdgfrb	3390	23	28
Bmp7	Acvr2a	59	3481	29
Prss23	Tmem222	1609	2058	30
Lamc1	Itgb1	1441	2286	31
Bmp7	Bmpr2	59	3711	32
Slit2	Sdc1	139	3661	33
Cntn2	Nrp1	3656	215	34
Col18a1	Itgb1	1610	2286	35
Lamb1	Itgb1	1668	2286	36
Pdgfa	Pdgfra	3390	756	37
Wnt7b	Fzd1	3770	416	38
Itgb3bp	Itgb5	1539	2719	39
Shh	Boc	4144	173	40
Jag1	Notch1	1811	2535	41
L1cam	Itgav	705	3688	42
Nlgn3	Nrxn1	2037	2422	43
Hspg2	Ptprs	2912	1554	44
Shh	Smo	4144	446	45
Sema4a	Plxnd1	2140	2573	46
Lama5	Sdc1	1057	3661	47
Col4a1	Itgb8	3909	1100	48
Sema6a	Plxna2	92	5011	49
Lamc1	Itgav	1441	3688	50
Col4a1	Itga1	3909	1225	51
Fgf18	Fgfr1	4294	888	52
Hspg2	Itgb1	2912	2286	53
Efna4	Epha3	53	5167	54
Ihh	Boc	5074	173	55
Gm11808	Egfr	3949	1299	56
Fgf17	Fgfr1	4395	888	57
Lamb1	Itgav	1668	3688	58
Sema3f	Plxna3	1051	4444	59
Sema3f	Plxna1	1051	4650	60
Ltbp1	Itgb5	3136	2719	61
L1cam	Itga5	705	5159	62
Efna4	Epha7	53	5902	63
Ctf1	Lifr	379	5686	64
Bmp8b	Bmpr1a	3723	2345	65
Bmp8b	Acvr1	3723	2361	66
Gdf5	Ror2	5373	786	67
Mfap2	Notch1	3648	2535	68
Col4a1	Itgb1	3909	2286	69
Wnt5a	Fzd1	5788	416	70
Vegfa	Itga9	6167	130	71
Gm11808	Acvr1	3949	2361	72
Lama1	Itgb8	5217	1100	73
Jag1	Notch4	1811	4507	74
Gm11808	Agtr1a	3949	2400	75
Wnt5a	Ror1	5788	573	76
Vegfa	Nrp1	6167	215	77
Bcan	Egfr	5100	1299	78
Lama1	Itga1	5217	1225	79
Gm11808	Notch1	3949	2535	80
Kitl	Kit	114	6397	81
Cdh1	Cdh2	261	6264	82
Serpine2	Lrp1	4321	2219	83
Hspg2	Sdc1	2912	3661	84
Wnt5a	Ror2	5788	786	85
App	Lrp1	4431	2219	86
Myoc	Fzd1	6289	416	87
Efna4	Epha1	53	6700	88
Col18a1	Itga5	1610	5159	89
Dusp18	Itga1	5562	1225	90
Tgfa	Egfr	5582	1299	91
Timp2	Itgb1	4792	2286	92
Il11	Gm13305	6455	633	93
Tac1	Tacr3	2816	4289	94
Efnb2	Epha3	2019	5167	95
Bmp8b	Acvr2a	3723	3481	96
Edn1	Ednra	6997	208	97
Il7	Il2rg	3521	3697	98
Ncam1	Fgfr1	6380	888	99
Dhh	Boc	7140	173	100

Supplemental Table 1 UB-SP3

Ligand	Receptor	Ligand rank	Receptor rank	Interaction rank
Slit2	Robo1	139	311	1
Efna4	Epha7	53	597	2
Slit2	Robo2	139	537	3
Cdh1	Egfr	261	439	4
Btc	Egfr	322	439	5
L1cam	Egfr	705	439	6
Bmp7	Bmpr1a	59	1247	7
Npy	Fap	1017	363	8
Fgf9	Fgfr1	1118	513	9
Cdh1	Cdh2	261	1499	10
Pdgfc	Pdgfra	1664	424	11
Kitl	Kit	114	2151	12
Sema3c	Plxnd1	771	1618	13
Sema3d	Nrp1	749	1661	14
Sema3c	Nrp1	771	1661	15
Fgf12	Fgfr1	1951	513	16
Kitl	Epor	114	2414	17
Bmp7	Eng	59	2586	18
Sema3f	Nrp1	1051	1661	19
L1cam	Ephb2	705	2153	20
Pdgfc	Pdgfrb	1664	1304	21
Slit2	Sdc1	139	3092	22
Bmp7	Acvr1	59	3234	23
Cdh1	Itgae	261	3048	24
Sema4a	Plxnd1	2140	1618	25
Pdgfa	Pdgfra	3390	424	26
Nrtn	Gfra1	17	3947	27
Col4a1	Itgb8	3909	113	28
Lama5	Sdc1	1057	3092	29
Efnb2	Ephb2	2019	2153	30
Sema3f	Plxna1	1051	3162	31
Shh	Boc	4144	105	32
Gm11808	Egfr	3949	439	33
Sema3f	Plxna3	1051	3409	34
Tac1	Tacr3	2816	1835	35
Pdgfa	Pdgfrb	3390	1304	36
Hspg2	Ptprs	2912	1812	37
Prss23	Tmem222	1609	3148	38
Wnt7b	Fzd1	3770	1024	39
Fgf18	Fgfr1	4294	513	40
Cgn	F11r	2929	1947	41
Fgf17	Fgfr1	4395	513	42
Bmp8b	Bmpr1a	3723	1247	43
Shh	Smo	4144	891	44
Ihh	Boc	5074	105	45
Bmp7	Bmpr2	59	5145	46
Lamc2	Itgb1	172	5139	47
Cntn2	Nrp1	3656	1661	48
Lama1	Itgb8	5217	113	49
L1cam	Itga5	705	4734	50
Nlgn3	Nrxn1	2037	3410	51
Npnt	Itgb1	338	5139	52
Bcan	Egfr	5100	439	53
Cdh1	Igf1r	261	5306	54
Btc	ErbB4	322	5315	55
Cdh1	Lrp5	261	5432	56
Shh	Cdon	4144	1550	57
Efnb2	Ephb3	2019	3684	58
Efna5	Epha7	5351	597	59
Wnt5a	Ror1	5788	161	60
Efnb2	Ephb4	2019	3962	61
Hspg2	Sdc1	2912	3092	62
Tgfa	Egfr	5582	439	63
Lama5	Itgb1	1057	5139	64
Jag1	Notch2	1811	4420	65
Eda	Edar	4171	2083	66
Nrtn	Gfra2	17	6297	67
Col18a1	Itga5	1610	4734	68
Efna1	Epha7	5758	597	69
Vegfa	Itga9	6167	245	70
Efna4	Epha5	53	6383	71
Gdf5	Ror2	5373	1064	72
Lamc1	Itgb1	1441	5139	73
Wnt11	Fzd7	41	6546	74
Vegfa	Egfr	6167	439	75
Gdf5	Bmpr1a	5373	1247	76
Ihh	Cdon	5074	1550	77
Il11	Gm13305	6455	193	78
Ncam1	Robo1	6380	311	79
Anxa1	Egfr	6255	439	80
Col18a1	Itgb1	1610	5139	81
Lamb1	Itgb1	1668	5139	82
Wnt5a	Fzd1	5788	1024	83
Wnt5a	Ror2	5788	1064	84
Ncam1	Fgfr1	6380	513	85
Jag1	Notch1	1811	5097	86
Wnt5a	Fzd2	5788	1160	87
Bmp8b	Acvr1	3723	3234	88
Fgf16	Fgfr1	6627	513	89
Gm11808	Acvr1	3949	3234	90
Dhh	Boc	7140	105	91
Itgb3bp	Itgb5	1539	5717	92
L1cam	Itgav	705	6560	93
Epgn	Egfr	6873	439	94
Myoc	Fzd1	6289	1024	95
Wnt4	Fzd2	6163	1160	96
Grp	Grpr	3325	4033	97
Efna5	Ephb2	5351	2153	98
Bmp3	Bmpr1a	6286	1247	99
Jag1	Notch4	1811	5833	100

Supplemental Table 1 UB-RV

Ligand	Receptor	Ligand rank	Receptor rank	Interaction rank
Efna4	Epha4	53	113	1
Bmp7	Acvr2b	59	281	2
Slit2	Sdc1	139	329	3
Cdh1	Cdh2	261	438	4
Slit2	Gpc1	139	712	5
Efna4	Epha7	53	1044	6
Fgf9	Fgfr1	1118	26	7
Lama5	Sdc1	1057	329	8
Lamc2	Itga6	172	1394	9
L1cam	Fgfr2	705	1003	10
Jag1	Notch1	1811	157	11
Fgf12	Fgfr1	1951	26	12
Fgf9	Fgfr2	1118	1003	13
Efnb2	Epha4	2019	113	14
Col18a1	Gpc1	1610	712	15
Slit2	Robo1	139	2214	16
Lama5	Itga6	1057	1394	17
Lamc2	Cd151	172	2323	18
Lama5	Bcam	1057	1452	19
Lamc2	Itga3	172	2445	20
Cdh1	Ptprm	261	2502	21
Lamc1	Itga6	1441	1394	22
Fgf12	Fgfr2	1951	1003	23
Cdh1	Igf1r	261	2769	24
Lamb1	Itga6	1668	1394	25
Hspg2	Col13a1	2912	158	26
Hspg2	Sdc1	2912	329	27
Wnt11	Fzd7	41	3385	28
Jag1	Notch2	1811	1618	29
Lama5	Itga3	1057	2445	30
Nrtn	Gfra1	17	3510	31
Efnb2	Ephb1	2019	1571	32
Bmp7	Bmpr1a	59	3658	33
Cdh1	Ptprf	261	3463	34
Mfap2	Notch1	3648	157	35
Lamc1	Itga3	1441	2445	36
Lamc2	Itgb4	172	3720	37
Bmp9b	Acvr2b	3723	281	38
Gm11808	Notch1	3949	157	39
Lamb1	Itga3	1668	2445	40
Nlgn3	Nrxn2	2037	2100	41
Wnt7b	Fzd10	3770	486	42
Slit2	Robo2	139	4134	43
Fgf18	Fgfr1	4294	26	44
Fgf17	Fgfr1	4395	26	45
App	Ngfr	4431	175	46
Lama5	Itgb4	1057	3720	47
Spint1	St14	368	4549	48
App	Gpc1	4431	712	49
Lamc1	Itgb4	1441	3720	50
Agrr	Lrp4	3593	1693	51
Fgf18	Fgfr2	4294	1003	52
Jag1	Notch4	1811	3487	53
Hspg2	Ptprs	2912	2473	54
Lamb1	Itgb4	1668	3720	55
Fgf17	Fgfr2	4395	1003	56
Efna5	Epha4	5351	113	57
Prss23	Tmem222	1609	3861	58
Cgn	Tgfb1	2929	2619	59
Gdf5	Acvr2b	5373	281	60
Cd24a	Selp	105	5619	61
Oxt	Oxtr	5503	293	62
Efna1	Epha4	5758	113	63
Sema4d	Plxnb1	4111	1781	64
Lama1	Gpc1	5217	712	65
Fgf9	Fgfr4	1118	4853	66
L1cam	Ephb2	705	5347	67
Inhba	Acvr2b	6107	281	68
Sema3c	Plxnd1	771	5617	69
Efna5	Epha7	5351	1044	70
Ncam1	Fgfr1	6380	26	71
Serpinc1	Gpc1	5752	712	72
Cgn	Ocln	2929	3615	73
Bmp3	Acvr2b	6286	281	74
Gm11808	Tgfb1	3949	2619	75
Inhba	Bambi	6107	499	76
Lama1	Itga6	5217	1394	77
Fgf16	Fgfr1	6627	26	78
Myoc	Fzd3	6289	380	79
Sema3c	Nrp2	771	5933	80
Myoc	Fzd10	6289	486	81
Efna1	Epha7	5758	1044	82
Fgf12	Fgfr4	1951	4853	83
Lamb3	Itga6	5432	1394	84
Vegfa	Gpc1	6167	712	85
Efna5	Ephb1	5351	1571	86
Il2	Ngfr	6756	175	87
Dusp18	Itga6	5562	1394	88
Hhip12	Cachd1	5382	1599	89
Sema3f	Nrp2	1051	5933	90
Col18a1	Gpc4	1610	5404	91
App	Slc45a3	4431	2593	92
Rspo4	Lgr4	5392	1708	93
Pigf	Flt1	341	6883	94
Timp2	Itga3	4792	2445	95
Ntf3	Ngfr	7067	175	96
Sema3f	Plxna3	1051	6193	97
Kitl	Epor	114	7140	98
Tac1	Tacr1	2816	4511	99
Efna1	Ephb1	5758	1571	100

