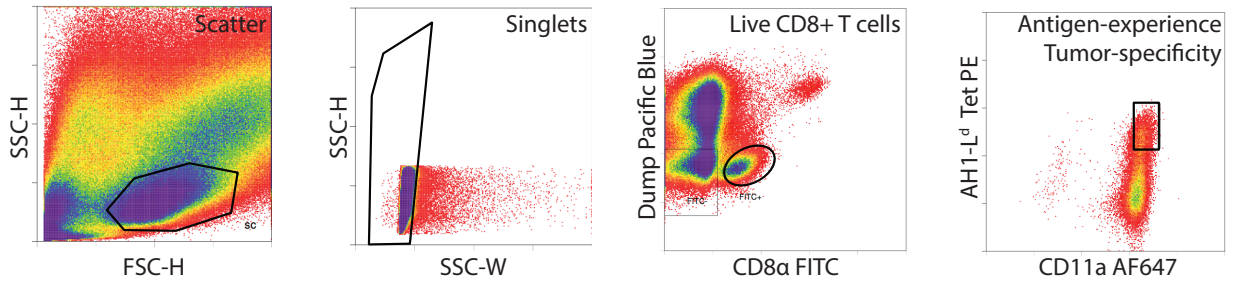
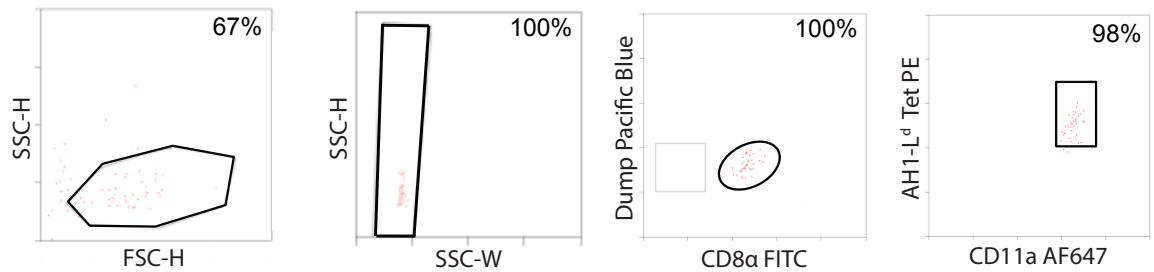


Supplemental material

Sort



Post sort



Supplemental Figure 1. Tumor-specific CD8⁺ T cells were isolated for microarray analysis from the timelines illustrated in Figure 2A. Representative FAC-sort of CD8⁺ 7-AAD⁻ CD4⁻ B220⁻ MHC-II⁻ CD11a⁺ AH1-L^d Tet⁺ cells from a tumor sample is shown. The “Dump” collectively refers to 7-AAD⁺, CD4⁺, B220⁺, and MHC-II⁺. For each sample, βgal-L^d Tet was used as a negative control to set AH1-L^d Tet gates. After FAC-sorts, all samples were 90-100% pure tumor-specific CD8⁺ T cells.

Supplemental Table 1. Transcriptional profiles of published T cell programs compared to tumor-specific TIL

T cell program of interest	Exhausted (overexpressed)	Exhausted (underexpressed)	Memory (overexpressed)	Memory (underexpressed)	Effector (overexpressed)	Effector (underexpressed)
T cell programs compared for relative gene expression	Exhausted virus-specific CD8+ T cells vs.	Naïve virus-specific CD8+ T cells; also not in memory and effector vs naïve virus-specific CD8+ T cells	Memory virus-specific CD8+ T cells vs.	Naïve virus-specific CD8+ T cells; also not in exhausted and effector vs naïve virus-specific CD8+ T cells	Effector virus-specific CD8+ T cells vs.	Naïve virus-specific CD8+ T cells; also not in memory, and exhausted vs naïve virus-specific CD8+ T cells
	Naïve virus-specific CD8+ T cells	Naïve virus-specific CD8+ T cells	Naïve virus-specific CD8+ T cells	Naïve virus-specific CD8+ T cells	Naïve virus-specific CD8+ T cells	Naïve virus-specific CD8+ T cells
Reference	Wherry EJ et al. 2007	Wherry EJ et al. 2007	Wherry EJ et al. 2007	Wherry EJ et al. 2007	Wherry EJ et al. 2007	Wherry EJ et al. 2007
Gene set	1110067D22Rik	1110038D17Rik	6330512M04Rik	2610019F03Rik	1110008P14Rik	1190002H23Rik
	1810035L17Rik/Nrp	1190002H23Rik	Acot7	Actn1	2810417H13Rik	2610019F03Rik
	2810417H13Rik	2610019F03Rik	Ahnak	Blk	Acot7	5730403B10Rik/Hmox2
	5730469M10Rik	2810407C02Rik	Anxa1	Ccr7	Actb	Abca1
	6330403K07Rik	4833420G17Rik	Anxa2	Cd24a	Adam19	Accs1
	Acot7	4922505G16Rik/Rpn2	Aqp9	Cd74	Ahnak	Actn1
	Adam19	A630038E17Rik	AW112010	Cd79b	Aim1	Amd-Ps6
	Ahnak	Abca1	Bag3	Cnn3	Anxa1	Amd1/Amd2
	Alcam	Abce1	Bhlhe40	Cxnc5	Anxa2	Amd1/Amd2
	Anxa2	Abim1	Casp1	Ddit4	Apobec2	Amd1/Amd2
	Art3	Acadm	Ccl5	Dntt	Atp5l	Apex1/Tmem55b
	Atf1/Gm1862	Acp5	Ccr2	Gsn	Atp5l	Bcl2
	Atf1/Gm1862	Accs1	Ccr5/Ccr2	H2-Aa	AW112010	Bzw2
	AW112010	Actb	Cebpb/Tmem189	H2-Ea-ps	Bag3	Ccnd2
	Bag3	Actn1	Crtam	H2-Eb1	Bhlhe40	Ccr7
	BC055004	Adcy7	Ctla2a	Idh2	Birc5	Cd72/Tesk1
	Bhlhe40	Add1	Ctla2b	Igf1bp4	Bub1	Clk1
	Bub1	Adh5	Ctla4	Igk-V28	C330027C09Rik	Clk4
	C330007P06Rik	Akap8	Cxcr3	Il6ra	Capn2	Cnn3
	C330027C09Rik	Anapc5	Ddx6	Il6st	Casp1	Ctsl
	Capzb	Arhgap1	Dock5	Igae	Casp3	Ctss
	Car2	Arhgef1	Dusp1	Kif23	Ccdc50	Cxcr4
	Casp1	Arl4c	Eil2	Lef1	Ccl5	Cxcs5
	Casp3	Asce1	Emp1	Lyz2	Ccl9	Ddx3x
	Casp4	Atp13a3	Eomes	Ms4a1	Ccnb1/Gm5593	Dgka
	Ccdc50	Atp6v0a2	Errfi1	Myb	Ccnb2	Dnajb2
	Ccl3	Atp6v0b	F2r	Pdk1	Ccr2	Dnajc7/Nkiras2
	Ccl4	Bnip3/LOC100044398/Gm10480	Fas1	Piga	Ccr5/Ccr2	Dntt
	Ccl5	Bzw1	Fcgr2b	Ppic	Cd48	Dph5
	Ccnb1/Gm5593	Bzw2	Fos	Rab3ip	Cdc6	Dtx1/Gm19706
	Ccnb2	Ccnd2	Fosb	Ramp1	Cdk1	Dusp1
	Ccr5/Ccr2	Ccr7	Gm6742	Scd1	Cks1b/Gm6340	Dusp6
	Ccr2	Cct3	Gm7278	Sfmbt2	Cks2	Eif4a2
	Cd160	Cct4	Gp49a	Smc4	Clic1	Eif4g1
	Cd200	Cct5	Gzmb	St6gal1	Cma1	Eif5/LOC100047658
	Cd244/LOC677008	Cct8	Gzmk	Tec	Cox17	Elov15
	Cd7	Cd1d1	Gzmm	Trim59	Cripl	Emb
	Cd84	Cd1d2	H2-Q10	Tspan32	Csda	Ets2
	Cd9	Cd24a	Hiatl1	Ttc14/Ccdc39	Ctla2a	Evl
	Cdk1	Cd72/Tesk1	Hopx		Ctla2b	Fam101b
	Chek1	Cdc42se2/LOC100045021	Id2		Ctla4	Fam134b
	Ch11	Cirh1a	Irfng		Ctsd	Fkbp3/Prp139
	Cit	Clk2	Il18r1		Cxcr3	Fos
	Ckmt2	Clk4	Il18rap		Cyfp1	Gadd45a
	Cks2	Cmah	Igae		Dennd5a	Gart
	Clic1	Cnn3	Igae		Dnajc15	Gas5
	Coch	Crlf3	Junb		Dock5	Gm1005/Hnmpa
	Cox17	Ctsl	Kcnj8		Dstn	Gm10052/Hnmpa
	Cpa3	Cxcs5	Klf4		E2f8	Gm5643/Hnmpa1
	Cpsf2	Cvtip	Klrf1		Ech1	Gm5803/Hnmpa1
	Cpt2	D10Wsu52e	Klrg1		Ect2	Gm7862
	Crygb	Ddx39b	Klrf1		Eil2	Gn3
	Cryl1	Ddx5	Lgals1		Emp1	H2-Aa
	Cst7	Dgka	Lilrb4		Eomes	H2-Ea-ps
	Ctla2a	Dnajc7/Nkiras2	Ly6a		Errfi1	H2-Ob
	Ctla2b	Dntt	Ly6c1/Ly6c2		Ezh2	Hmgn1/LOC100044391
	Ctla4	Dph5	Ly6c1/Ly6c2		F2r	Hnmpa1L2/Loc6
	Cxcl10	Dscam1	Mdfic		Fas1	Hnmpa1
	Cxcr3	Dtx1/Gm19706	Myo1f		Fcgr2b	Hspa9
	Cyfp1	Eef2	Nrp1		Fgl2	Igf1bp4
	Dock5	Eif2s1	Null		Figl1	Il4ra
	Dock7	Eif4a2	Ode1		Fyn	Il6ra
	E2f8	Eif4g1	Pglyrp1		Gapdh	Il6st
	Ect2	Elov15	Prr1		Gapdh	Il7r
	Eea1	Emb	Prr13		Gapdh	Isoc1
	Eil2	Emi5	Rn18s/Rn45s		Gapdh/Gm2606	Igae
	Entpd1	Eng	Rnf138		Glrx	Itm2a
	Eomes	Emk1	Runx2		Gm10124	Itp2
	Etf1	Ets1	S100a4		Gm10291	Kctd12/Mir5130
	F2r	Evl	S100a6		Gm10291	Lef1
	Fas1	Fam101b	St3gal6/Dcbl2		Gm11401	Mdm4
	Fgl2	Fam102a	Tnfrap3		Gm12070/Gapdh	Mettl8
	Figl1	Fam134b	Txndc5		Gm12070/Gapdh	Mettl9
	Fyn	Fkbp4			Gm12070/Gm2606	Mhl1
	Gapdh	Fos			Gm12070/Gm4609	Morf412
	Gapdh	Frat2			Gm14148	Ms4a1
	Gapdh	Gadd45a			Gm14407	Myb
	Gapdh	Glt25d1			Gm2467	Mye

Gapdh/Gm12070	Gm10845			Gm2606/Gm10291	Mycbp2
Gas2	Gm13777			Gm3671	Nedd4l
Gcdh	Gm14165			Gm3809	Nfkbiz
Gdf3	Gm14407			Gm4804	Nrip1
Gdpd5	Gm2a			Gm4929	Nsg2
Gem	Gm4638/Gm4671			Gm5068	Null
Glrx	Gm4671			Gm5177	Nxf1
Gm10291	Gm4761			Gm5523/Gapdh/Gm12070	P2rx4
Gm10291/Gm1029	Gm4833			Gm6340	Parp8
Gm12070/Gapdh	Gm4959			Gm6946	Pdk1
Gm12070/Gapdh	Gm5148			Gm7123	Peli1
Gm12070/Gapdh	Gm5191			Gm7183	Phf12
Gm14148	Gm6983			Gm7286	Piga
Gm2467	Gm7246			Gm8055	Pkp4
Gm2606/Gm10291	Gm7290			Gm8174	Plekha1
Gm3671	Gm7862			Gm8513	Ppic
Gm3809	Gm8231			Gm8681	Prkd3
Gm4804	Gm8624			Gm9028	Rab3ip
Gm4833	Gm9514			Gm9034	Ramp1
Gm4929	Gnas			Gm9081	Rere
Gm5068	Gnb211			Gm9238/Loc6776	Rgs10
Gm5177	Gnl3			Gm9568	Satb1
Gm5523/Gapdh/Gm12070	Gsn			Gp49a	Scd1
Gm6946	Gtf2i			Gzma	Sell
Gm7123	H2-Ke6			Gzmb	Sema4b
Gm7183	H2-Ob			Gzmk	Sfmbt2
Gm7286	Hba-a1/Hba-a2			H2-Q1	Sfns7
Gm8055	Hba-a1/Hba-a2			H2-Q10	Slc12a7
Gm8174	Hbb-b1/Hbb-b2/Beta-s			H2-Q2	Smad1
Gm8231	Hexa			H2-Q6/H2-Q8/LOC68395	Smad7
Gm8513	Hmgcs1			H2-Q6/H2-Q8/LOC68395	Smarca2
Gm8681	Hmgn1/LOC100044391			H2-Q7/H2-Q9/H2-Q8/H2-Q6/LOC68395	Smc4
Gm9028	Hmha1			H2-T10/H2-T9	Snhg5
Gm9034	Hnrnpu			H2afz	Soes3
Gm9081	Hspa8			Hba-a1/Hba-a2	Spred2
Gm9568	Icam2			Hba-a1/Hba-a2	Ssbp2
Gp49a	Idh2			Hbb-b1/Hbb-b2/Beta-s	St6gal1
Gpd2	Ifnar1			Hiatl1	Tcf12
Gpr56	Igk-V28			Hist3h2a/Trim17	Tcf7
Gpr65	Ikbke			Hmgb2	Tec
Gzma	Il17ra			Hopx	Tgtp1/Tgtp2/Gm12185
Gzmb	Il4ra			Id2	Tlr6
Gzmk	Il6ra			Ilfng	Tnfaiip8
Hiatl1	Il6st			Il18r1	Tspan13
Hist3h2a/Trim17	Il7r			Il18rap	Tsr1/Srr
Hmgb2	Ilvbl			Il1rl1	Ttc3
Id2	Impdh2			Irga4	Vcam1
Ih1	Isoc1			Irgax	Wdr92
Ihng	Itgae			Irgb1	Xlr3b/Xlr3c/Xlr3a
Irf4	Irgb7			Irgb2	Xlr3b/Xlr3c/Xlr3a
Irf8	Kenn4			Kif11	Xlr3b/Xlr3c/Xlr3a
Isg15	Kctd10			Klra3/LOC100862437/LOC100862410/Klra9	Zbtb20
Isg20	Kdm3a			Klra9/Klra3/Klra10	Zfp281
Irga4	Klf13			Klrc1	Zmym6/Gm12942
Irgav	Klf2			Klrg1	
Irgb1	Klf3			Klrk1	
Irh5	Klk8			Kpna2	
Jak3/Ins13	Klrd1			Lgals1	
Klf10	Kpnb1			Lgals3	
Klk1/Klk1b5/Klk1b4	Lbr			Lilrb4	
Klra3/LOC100862437/LOC100862410/Klra9	Lck			Lonrf1	
Klra9/Klra3/Klra10	Lef1			Lxn	
Klrg1	Ltb			Ly6a	
Kpna2	Lyz2			Ly6c1/Ly6c2	
Lag3	Macf1			Ly6c1/Ly6c2	
Lat2	Map4k4			Mad211/LOC100045924	
Lclat1	Mapk8			Mdfic	
Lgals1	Mat2a			Med121	
Lgals3	Mettl8			Mki67	
Lilrb4	Mettl9			Myo1f	
Litaf	Mipol1/Prps113			Ndufa6	
Lman2	Ms4a1			Nrp1	
Lonrf1	Nedd4l			Null	
Ly6a	Nfe212			Nusap1/Oip5	
Mad211/LOC100045924	Nfkbiz			Pbx3	
Mdfic	Npc2			Pfkb	
Mki67	Nsg2			Pglyrp1	
Mrp146	Nsun2			Phf13	
Mx1	Null			Plscr1	
Myb4	Numb			Polc3	
Ndfip1	Nxf1			Prc1	
Nfate1	Osbp111			Prdm1	
Nfil3	Pak2			Prl1	
Nped/Cbx6/Nptxr	Pdha1/Map3k15			Prr13	
Nr4a2	Pdk1			Ptgr1	
Nrp1	Peli1			Racgap1	
Nucb1	Piga			Reep5	

Null	Pik3cd			Rhoq/Pigf	
Nusap1/Oip5	Pitpnc1			Rn18S ??=>?? 10445185 Rn18s/Rn45s OR 10536170 Rn18s/Rn45s	
Pawr	Plac8			Rora	
Pbx3	Pld3			Rpa2	
Pdcd1	Ppp2R5a			Rpl27a	
Penk	Ppp2R5a			Rpl27a	
Perp	Prdx6/LOC677654			Rpl27a	
Pglyrp1	Prkd2			Rpl38	
Plin2	Prkd3			Rrm2	
Plk4	Prps1			Runx2	
Plscr1	Prps111			S100a10	
Pon2	Ptpn6			S100a11	
Pqlc3	Ptprc			S100a13	
Prc1	Rabac1			S100a4	
Prdm1	Ramp1			S100a6	
Ptger2	Rap1gds1			Sec61g	
Ptger4	Rbm38			Serpinb9	
Ptpn13	Rere			Sh2d1a	
Rbm39	Rgs10			Sh3bgr1	
Rcn1	Rpl10			Slc4a7	
Rgs16	Rpl10a			Smc2	
Rhoq/Pigf	Rpl10l			Snx10	
Rnfl1	Rpl13			St3gal6/Dcblid2	
Romo1	Rpl22/LOC100504863			Stard10	
Rpa2	Rpl27a			Stmn1	
Rpl38	Rpl27a			Tacc3	
Rps4X	Rpl27a			Tceb2	
Rps4x	Rpl28			Tmem49/Mir21	
Rrm2	Rpl28			Top2a	
Rsad2	Rpl3			Trappc1	
Runx2	Rpl8			Txn1	
S100a11	Rplp0			Txndc5	
S100a13	Rplp1				
S100a4	Rps16/Gm10079				
S100a6	Rps23				
Scin	Rps23/Gm5148/Gm8618				
Sec61g	Rps28				
Sept4	Rps3				
Serpinb6a	Rps3a				
Serpinb9	Rps3a				
Sh2d2a	Rps4x				
Sh3bgr1	Rps4x				
Shkbp1	Rps7				
Slc29a1	Rps8				
Slc4a7	Rps8				
Smc2	Rps8				
Snrpb2	S1pr4				
Snx10	Satb1				
Spock2	Scd1				
Spp1	Sdha				
Stmn1	Sell				
Svpl	Sema4a				
Tacc3	Simbt2				
Tank	Sfpq				
Tbc1d22a	Sgk1				
Tcea2	Shah1a				
Terg-V3/Terg-V	Skp1a				
Tcta	Slc12a7				
Tctn3	Slco3a1				
Tfdp1	Smad1				
Tmem109	Smarca2				
Tnfrsf1a	Snord15b/Rps3				
Tnfrsf1b	Snord38a/LOC100862183/Gm15501/Rps8				
Tnfrsf9	Snrpd3				
Top2a	Snx4				
Tor3a	Spnb2				
Trim25	Srpk1				
Trim47	Ss18				
Ttc39b	Ssbp2				
Tubb2a	St6gal1				
Txn1	Stk38				
Ube2t	Supt4h1/Gm3258				
Vamp7	Supt4h1/Gm3258				
Vamp8	Supt5h				
Vmp1	Tcf7				
Vps37a/Mtmr7	Tec				
Wbp5	Tgtp1/Tgtp2/Gm12185				
Wnk1	Tlr6				
Zfp91-Cntf/Zfp	Tmc6				
	Tmed2				
	Tmem50b				
	Tmem66				
	Trim28				
	Tsr1/Srr				
	Ttc3				
	Tubb5				
	Twf2				

	Ubp1/Fbx12				
	Use1				
	Wdr92				
	Xlr3b/Xlr3c/Xlr3a				
	Xlr3b/Xlr3c/Xlr3a				
	Xlr3b/Xlr3c/Xlr3a				
	Zfp36				
	Znr2				

T cell program of interest	Self tolerant (overexpressed)	Self tolerant (underexpressed)	Deletional tolerance (overexpressed)	Deletional tolerance (underexpressed)	Anergy (overexpressed)	Anergy (underexpressed)
T cell programs compared for relative gene expression	Tolerant self-specific CD8+ T cells (K means clusters 9 and 13) vs.	Functionally rescued tolerant and memory self-specific CD8+ T cells (K means clusters 7, 8, 10, 11 and 14) vs.	CD8+ T cells undergoing deletional tolerance vs.	CD8+ T cells during immunity and lymphopenia-induced proliferation vs.	Various anergic T cells vs.	Various anergic T cells vs.
	Naïve and memory self-specific CD8+ T cells	Tolerant self-specific CD8+ T cells	CD8+ T cells during immunity and lymphopenia-induced proliferation	CD8+ T cells undergoing deletional tolerance	Various T cell programs	Various T cell programs
Reference	Schietinger A et al. 2012	Schietinger A et al. 2012	Parish IA et al. 2009	Parish IA et al. 2009	Parish IA et al. 2009; Redmond WL et al. 2005; Davey GM et al. 2002; Schwartz RH, 2003; Rocha B et al. 1995; Hernandez J et al. 2001	Parish IA et al. 2009; Davey GM et al. 2002
Gene set	Cd81 Clspn Cdc20 Kif15 Tefl9 LOC237877 Lag3 Tnfrsf9 Aurka Beat1 Tfr Iccnp Mcm10 Hmgn3 Snn/Txndc11 Esp1 Hist1h3e Chf18 Hist1h2bn Kntc1 Gtse1 Sgol1 Ecm1 Kif18b Hist1h3a Kif2c Cdea2 Fancd2 Detpp1 Cdc6 Chaf1a/Ubxn6 Chst2 Spag5 Hist1h2bm Cldn10 Igf2bp3 Nhede2 Apitd1 Ccdc99 Lig1 Stmn1 Zranb3 Cdc45 Mareks11 Rgs16 Ptpla Chst3 Cenpm Ptprs Ncapd2 Nrgn Hist1h3c Sox5 Hist1h3d Sxb Nrn1 Hist1h2bh Rcc1 Bub1b Hist1h2bj Hist1h2ab Tpi1 Mcm5 Nmra1 Rad51 Cdea7	1700025G04Rik 4930486L24Rik Abcb9 Abhd14b Acpl2 Acsbg1 Acy1 Adssl1 Ahnka Aim1 Alad Alox5ap Amica1 Ank Anxa3 Ap1g2/Thtpa Apobr/Cln3 Aqp1 Aqp9 Arl4d Arzb Asb2 Ass1/Gm5424 Axl Bag3 Bbc3 Bbs9 BC021614 Bel2 Bhlhe40 Blvrb Clqb Clqc Clqtnf4 C3 Camk2n1 Camp Car11 Casp1 Casp4 Ccl4 Ccl5 Ccl9 Cer5/Ccr2 Cd163i1 Cd177 Cd22 Cd44 Cd63 Cd7 Cd74 Cdc42ep3 Cdh1 Cdk5rap1 Cdkn2c Cebpb/Tmem189 Cebpe Chi311 Chi313 Chi317 Cobll1 Csprs/Gm7609 Ctsa Ctsw Cxcr3 Cxcr5	4921525O09Rik 4930539E08Rik A830073O21Rik Cd20041 Crem Cyth3 Dgkz Egr2 Egr2 Endod1 Ephx1 Fcerl1 Galm Gpm6b H3f3b/Gm12657/Gm6749/H3f3c/H3f3a Hspa41 Ikzf2 Lpcat1 Lrig1 Lta Marcks Mdh1 Nab2 Nr4a1 Nr4a3 Nrip1 Nrn1 Pacsin1 Prmt2 Ptprs Rasa1 Reep3 Rgs16 Skil Soat1 Ssh1 Synj2 Tbc1d4 Tnfrsf11 Tox Ypel2	6330409N04Rik Axin2 Dtx1/Gm19706 Fech Gimap7 Gzma H2-Aa Hbb-bh1 Il18rap Klf3 Ly6a Ly6c1/Ly6c2 Lyz1 Lyz2 Nedd4 Psmb2 Rras2 Sike1 Snca Sytl1	Cblb Cd5 Cdkn1b Ctla4 Dgka Dgkz Egr2 Egr3 Itch Nfatc2 Pag1 Pdcd1 Rnf128	Tob1

Spe25	Cxcr6				
Ndrp1	Cyb5r4				
Pdzd11/Kif4	D14Ertnd668e				
Rilp12	D8Ertnd82e				
Pif1	Dapk2				
Cenpa	Dennd3				
Rad54l	Dkk1l				
Hist1h3h	Dmrta1				
Cenpn	Dstn				
Hist1h2bk	Ear2				
Hist1h2bf	Elane				
Rad54b/Fsdp	Emilin2				
Cdc7	Emr1				
Itm2a	Eomes				
Fibcd1	Epb4.113				
Xcl1	Epsti1				
Sh3bp2	Eraf				
Top2a	Errfi1				
Hist1h2af	F2r				
Ppic	F2r1				
Hist1h2an	Fam26f				
Cdk1	Fcgr4				
Birc5	Fcgrt				
Hist1H2ag	Fcna				
Hist2ab	Fgfl3				
Litaf	Fndc3b				
E2f2	Fpr3/Fpr2				
Pre1	Gab3				
Cdca3	Gas7				
H2afx	Gata3				
Hist1h2ah	Gatsl3				
Nusap1/Oip5	Gbp3				
Ppa1	Gimap7				
Tyms/Tyms-ps	Glrx				
LOC100047934	Gm12253				
Ccnb1/Gm5593	Gm4814/Cmya5				
Psat1/LOC100047252	Gng2				
Pbk	Gpc1				
Hist1h2ak	Gpr183				
Mcm6	Gramd3				
Hist1h2ad	Gsto1				
Tyms-ps	Gtde2				
Uhrf1	Gvin1/Gm4070				
Krlb1c	Gznm				
Adk	H2-Ab1				
Rml1	H2-DMb2/H2-DMb1				
Hist1h2ao	H2-Eb1				
Tnfrst2l	Hcst				
2810417H13Rik	Hdc				
Scamp1	Hebp1				
Chn2/9130019P16Rik	Hk3				
Lmnb1	Hmox1				
Anln	Hp				
Rrm2	Hsd11b1				
Pkm	Ier3				
Kif22	Ifi30				
Prm2/Wdr19	Ifit3				
Plk1	Ifitm2				
Mad211/LOC100045924	Ifitm3				
LOC100045304	Ifitm6				
Ncaph	Ifng				
E2f1	Ifngr1				
Hist2H2ac	Il10ra				
Tk1	Il12rb1				
Fen1	Il18r1				
Fign1	Il18rap				
D17H6S56E-5	Il1b				
Ndrp1	Il7r				
Mcm2	Inpp1				
Kif11	Insl6				
Cdca5	Itgad				
Chaf1b	Irgb1				
Capg	Kcnj8				
Endod1	Kcnk6				
Cenph	Klra16				
Galk1/Itgb4	Klra7				
Swap70	Klra9/Klra3/Klra10				
LOC100047651	Klire1				
Geod1	Klrk1				
	Lat2				
	Lcn2				
	Lgals3bp				
	Lmna				
	Loc100046232				
	Loc100046608				
	Loc100047167				
	Loc100048346				
	Loc641240				
	Lpxn				

Lrg1				
Lrrk1				
Ltb4r1				
Lif				
Ly6a				
Ly6c1/Ly6c2				
Ly6e				
Lyz1				
Lyz2				
Lyz2				
Mapre2				
Mdfic				
Med7				
Mfsd10				
Mgst1				
Milkl				
Mmp9				
Mocos				
Mpo				
Mrc1				
Mrpl52				
Ms4a6d				
Mtl				
Myadm				
Myl4				
Myo1f				
Myo6				
Naip2				
Nans				
Nccrp1				
Ncf4				
Ngp				
Nkg7				
Nod1				
Nrarp				
Nt5e				
Nuak2				
Nudt4				
Oas1g/Oas1a				
Osbp13				
P2ry14				
Pde2a				
Ptkp				
Phf11				
Pkig/Gm6334				
Plac8				
Plcg2				
Plek/Chrip1				
Plekhg3				
Plscr1				
Pou6f1				
Pqle3				
Prfl				
Prtn3				
Ptpn12				
Pygl				
Rab19				
Rab31				
Rap1gap2				
Rassf4				
Reck				
Retnlg				
Rgs1				
Rnf138				
Ryk				
S100a6				
S100a8				
S100a9				
Samd3				
Scly				
Sen2b				
Sdc3				
Sdcbp2				
Sepr1				
Serpina3f/Serpina3g				
Serpina3f/Serpina3g				
Serpina6b				
Sidtl				
Sla				
Slamf7				
Slc11a1				
Slc38a5				
Slc39a4				
Slc40a1				
Slc4a1				
Slc52a3				
Slpi				
Smad3				
Sntb2				

	Snx10			
	Snx8			
	Soat2			
	Sort1			
	Sort1			
	Spin2			
	St3gal6/Deblid2			
	St6galnac4			
	Stard10			
	Stat4			
	Susd3			
	Swap70			
	Svt2			
	Tbx21			
	Tdrd7			
	Tgfb1			
	Tgm2			
	Tm6sf1/Hdgfrp3			
	Tmem51			
	Trem3			
	Trf/Sprb			
	Tshz3			
	Ttc39b			
	Txndc5			
	Tyrobp			
	Uap111			
	Ublep1			
	Unc93b1			
	Usp18			
	Vcam1			
	Vim/LOC100862060			
	Vkore1			
	Wdr95			
	X99384			
	Zc3h6			
	Zcchc18			
	Zfhx2/Zfhx2as			
	Zfp296			
	Zfp3			
	Zscan12			

T cell program of interest	Patient TILN (overexpressed)	Patient TILN (underexpressed)	All CD8+ TIL (overexpressed)	All CD8+ TIL (underexpressed)
T cell programs compared for relative gene expression	Tumor-specific CD8+ T cells from a tumor vs.	Tumor-specific CD8+ T cells from the periphery vs.	200 most differentially expressed genes of all CD8+ TIL (regardless of specificity), from a mouse model of melanoma vs.	200 most differentially expressed genes of all naive CD8+ T cells from the spleen vs.
	Tumor-specific CD8+ T cells from the periphery	Tumor-specific CD8+ T cells from a tumor	Naive CD8+ T cells from the spleen	All CD8+ TIL (regardless of specificity), from a mouse model of melanoma
Reference	Baitsch L et al. 2010	Baitsch L et al. 2010	Giordano M et al. 2015	Giordano M et al. 2015
Gene set	4931431C16Rik/Acox3	Abhd14b	Acsbg1	Abcc5
	Ak2	Anapc5	Actg1	Abcg3
	Algl10b	Atg16l1	Ahnak	Acot2
	Angptl6/A230050P20Rik	Atg3	Ap2m1	Adar
	Apeh	Atp2b1	Atp2b4	Akr1b3/Gm6644
	Atf3	BC005561	Batf	Ank
	Atf4	Blmh	Bcl2a1c	Ap1ar
	Becn1/Cntd1	Cacybp	Bcl2a1d	Arhgef18
	Bst2	Casp8	Bcl2l1	Arid3b
	Calm4	Cd300e	Calm2/Calm3/Calm1	Arpc1b/Gm5637
	Cblb	Clpx	Calu	Atp6ap2
	Cct6a	Cog4	Camk2n1	Atp6v0a1
	Cd27	Comm2	Caml	Bace1
	Cklf	Cox6b1	Casp1	Bbs9
	Cltb	Cul4a	Casp8	Bcl9
	Cotl1	Derl2/LOC100862452	Ccdc72	Brix1
	Cpt1c	E2f1	Ccl25	Carhsp1
	Crtam	Eif4g3	Ccl3	Ccdc101
	Csnk2a2	Fbxo3	Ccl4	Ccdc114
	Ctla4	Flna	Ccl5	Ccdc30
	Cxcl13	Fxyd5	Cer5/Cer2	Ccdc64
	Dclre1c	Fzr1	Cct5	Cd2ap
	Ddx11	G3bp1	Cdt1	Cept1/Dennd2d/Dram2
	Dgke	Gins4	Cerk1	Chmp2a
	Dtnbp1	Gk5	Crem	Chrn1
	Dusp16	Golga4	Csnk2a1	Cmah
	Dusp4	Inpp5d	Ctla2a	Col10a1
	Dusp5	Itgam	Ctla2b	Cpeb4
	Erb2ip	Jhdm1d	Ctss	Cyth1
	Erf	Kcmn1	Cul2	Dap11
	Exoc4	Lrrc47/1190007F08Rik	Cxcl10	Ddx23
	Exoc5/Mudeng	Lyar	Cyp51	Ddx39
	Exoc7	Metap1	Cysl2r2	Dlg1
	Fam105b	Mif4gd	Dcaf5	Dph5
	Fam53c	Myo1f	Ddx3x	Drg1
	Fos	Ndufs8	Ddx54	Dtnb
	Galm	Nf2	Dennd4a	Ears2
	Gapvd1	Nr3c1	Dhx58	Eif3j/Gm9781

Gbp1/Gbp5/LOC100047734	Pdcd2	Dnajb1	Entpd4/LOC100862375
Gcc2	Pik3r1	Dusp1	Eya2
Gem	Pno1	Ecd	Fam53b
Gm10784	Polr1d	Eif5a13-ps	Fam65b
Gm5472	Pom121/Nsun5	Emgl/L.peat3	Fkbp15
Gm6560	Ppp2r5c	Eml5	Fntb/LOC639541
Gpr19	Ppp3r1/Wdr92	Eomes	Foxk1
Gramd1b	Ppp4r1	Ergic2/Far2	Foxk1
Hdgf	Psma2	F2r	Fry
Hdhd2	Pxn	Fam46c	Ggnbp1/Zbtb9
Hlip1	Rbl2	Fam96a	Ggt1
Hspd1	Rev3l	Fbxo40	Gmps
Icos	Rpl18a	Fcer1g	Gon4l
Ier3ip1/Hdhd2	Rpl18a	Frrs1	H3f3a
Ifng	Samhd1	Fyn	Haus7/LOC100048005
Il2/Snapin	Scaf1l	Gabarap	Hs6st1
Irf4	Sh3bgrl3	Gatad2a	Hspa14/LOC100861945
Irga1	Ssbp3	Gch1	Igf1r
Irm2a	Ssbp4	Glccl1	Igfbp4
Jmjdlc	Thoc2	Gng2	Ikbke
Jtb	Tmub2	Golph3	Il6st
Kif3b	Tnfrsf25	Gp49a	Ino80
Lasp1	Tpst2	Gramd1b	Irgm2/Igtp
Lix1l	Traf3ip3/A130010115Rik	Gramd4	Isg2012
LOC545845	Txnip	Grina	Kcnmb1
Mapre2	Ube2b	Gzmb	Kif9
Mbn1l	Uqcrq	H2-Ab1	Klhl22
Mcl1	Vdac2	H2-Ea-ps	Krtap5-4
Mcm6	Zbtb44	H2afy	Larp1b
Myo7a	Zyx/Epha1	H2afz	Las1l
Ndfip1		Hba-a1/Hba-a2	Limd2/LOC632329
Ndufc2/LOC675851/LOC635087		Hip1	Lin52
Neil2		Hmbox1	Lrre51
Nfat5		Hmgb2	Map2k5
Nod2		Hsp90aa1	Map3k7
Nploc4		Hspa1a	Map4k2
Otud7b		Hsph1	Mbp
Parvb		Icam1	Mdn1
Parvg		Idh3a	Med20
Pcbp2/Map3k12		Ier3	Mettl3/Tox4
Pes1		Ifi35	Mfsd4
Phlda1		Ifit3	Miip
Pik3ip1		Igf2r	Mpdu1
Pik3r1		Il18bp	Msh3
Pkm		Il2rb	Mtch2
Polr1d		Irgm1	Mthfd1
Pom121/Nsun5		itgb1	Mthfd11
Ppp1cc		Iws1	Myc
Ppp1r2		Kif10	Myliip
Ppp1r2/Ppp1r2-ps3		Klra23	N6amt1
Ppp1r2/Ppp1r2-ps3		Klrc1	Nadk
Prdx5/Trmt112		Krr1/Glipr1	Nap114
Psenen		Lag3	Npas2
Ptprj		Lass2	Nsg2
Rab27a		Lilrb4	Nsun2
Rala		L.peat1	Nuch2
Ranbp2		Lphn1	Nup188
Rdh10		Lsm3	Osbp17
Rgs1		Lsm6	Pak1ip1
Rgs3		Lsr	Parp1
Rnf24		Ly6c1/Ly6c2	Pcsk1
Sardh		Lzic	Pdcd11
Sat1		Mad211/LOC100045924	Pdzk1/Gpr89
Sema7a		Maf	Pecam1
Slc7a5		Map2k3	Pias1
Snx9		Med29	Pik3ip1
Sod1		Mex3c	Pip4k2a
Spg7		Mgat2	Pmel1
Spry1		Mpeg1	Pphln1
Stat3		Mrpl43/Sema4g/Peo1	Ppm1h
Stx1a		Mrps33	Ppp1r9b
Tap1		Mxd4	Prdm2
Tatdn1/Rnf139		Nacc1	Prkar2b
Tceal3/Tceal6/Tceal5		Nae1	Pspe1
Tig		Nbeal2	Pten
Tmcc1		Nfyb	Pter2
Tnfrsf9		Nr4a2	Pts
Topors/2010003O02Rik		Nr4a3	Qdpr
Tox		Ociad1	Rab14
Traf3		Ode1	Rab40b
Traf5		Padi2	Rab711
Trib1		Pdcd1	Rad9b
Tspyl2		Plekha2	Ramp1
Tuba4a		Plk3	Rapgef6
Vtal		Pop4	Rasa3
Ypel5		Ppih/Gm17748	Rcbtb1
Ze3h12a		Ppp3cb	Rcbtb2
Ze3h12c		Ppp3cc	Recql/Pyroxd1

Zland5		Pqlc3	Rfx3
Zfp361l		Prdx1/LOC100862012	Rnf115
Zmym2		Prked	Rnf41
Znrf1		Prl8a8	Rpfl
		Prrc2c	Rpl18a
		Psm8	Rps15a
		Ptger4	Rps6ka1
		Ptpre	Rps6kc1
		Rab19	Rsph4a
		Rab8b	Rwdd4a
		Rbbp7	Rxb
		Rbm18/Mrrf	Sbds
		Rbm22	Sdad1
		Rgs1	Sdha
		Rgs16	Sec13
		Rpl221l/Gm15421	Sec22b
		Rpl27	Sema4f
		Rpl27-ps2	Sfxn2
		Rpl36a/Rpl36al	She
		S100a10	Skap1
		S100a4	Slamf6
		S100a6	Slc26a10/B4galnt1
		Samd3	Slc43a2
		Sars2	Slnf5
		Setd8	Snx12
		Sft2d1	Spes2
		Slc16a6/LOC100503496	Spna2
		Slc25a3/LOC100046151	Stard5
		Slc38a2	Stau1
		Slc3a2	Stx6
		Smarcc1	Suv420h1
		Smarcc1	Tardbp/Masp2
		Smek1	Tas2r114
		Snrpd2	Tbc1d22b
		Snx10	Tcf12
		Son	Tcf3
		Spata13	Tcf7
		Ssty2	Tcigr1
		Stat3	Tera-V8
		Stat6	Terb-J
		Surf1/Surf2	Tex9
		Taf15	Timm8a1
		Tcf4	Tlr1
		Tcrg-V2	Tm6sf1/Hdgfrp3
		Tex10/Invs	Tnik
		Tex2	Trak2
		Figit	Trav12n-1
		Tmed2	Trpm7
		Tmem50b	Tuba3a/Tuba3b
		Tmem63a	Tubal3
		Tmem88/Lsmd1	Tubgcp4/Trp53bp1
		Tmpo	Utp14a
		Tnfr3	Vat1
		Tnfrsf9	Vbp1
		Trappe6b	Vmn2r96
		Trf/Srprb	Vps26b
		Ttc38	Vps8
		Txn1	Wapal
		Ubash3a	Wdfy1
		Ube2l3	Wtap
		Ubl3	Xist
		Ubp1/Fbxl2	Xlr5a/Xlr5b/Xlr5c
		Uhrf2	Xrec3
		Usp48	Xrec5
		Vim/LOC100862060	Xrn1
		Wdr45l	Yeats4
		Wipi2	Yipf6
		Xlr4b/Xlr4a/Xlr4c	Zbtb22
		Zbtb44	Zcche7
		Zc3h12d	Zfml
		Zc3h13	Zfp157
		Zfp36	Zfp330
		Zmiz2	Zfp826
		Zmynd11	Zgpat

Supplemental Table 1. Transcription profiles of published T cell programs compared to tumor-specific TIL. Gene sets were compiled from previously published lists of differentially expressed genes associated with CD8+ T cell programs that are most relevant to TASP T cells.

Supplemental Table 2. Overlap between hypofunctional CD8+ T cell programs that share increased gene expression with TASPR TIL

75 (a)					
Anln	Cdca3	E2f1	Kif11	Ndrgr1	Rrm1
Apitd1	Cdca5	Ecm1	Kif15	Nmral1	Scamp1
Aurka	Cdca7	Esp11	Kif18b	Nrgn	Sgol1
Bcat1	Cenpa	Fancd2	Kif22	Pbk	Sh3bp2
Birc5	Cenph	Fen1	Kif2c	Plk1	Spag5
Bub1b	Cenpm	Galk1/Itgb4	Kntc1	Ppa1	Spc25
Capg	Cenpn	Gtse1	Lig1	Ppic	Tcf19
Ccdc99	Chaf1b	H2afx	Lmnb1	Psat1/LOC100047252	Tk1
Cdc20	Chtf18	Hist1h2ak	Mcm10	Ptpla	Tpi1
Cdc45	Clspn	Hist1h2bh	Mcm2	Rad51	Tyms-ps
Cdc6	D17H6S56E-5	Hist1h2bm	Mcm5	Rad54b/Fsbp	Tyms/Tyms-ps
Cdca2	Dctpp1	Hmgn3	Ncapd2	Rad54l	Uhrf1
			Ncapb	Rcc1	Xcl1
110 (b)					
1110067D22Rik	Cd160	Entpd1	Isg20	Nrp1	S100a11
1810035L17Rik/Nrp	Cd200	Etf1	Itgav	Nucb1	S100a4
5730469M10Rik	Cd244/LOC677008 (2B4)	Fgl2	Itih5	Pawr	Serpnb6a
Acot7	Cd9	Gapdh	Klra3/LOC100862437/LOC100862410/Klra5	Pdcd1 (PD-1)	Serpnb9
Alcam	Chek1	Gas2	Klra9/Klra3/Klra10	Penk	Sh3bgr1
Anxa2	Chl1	Gdpd5	Kpna2	Perp	Sle29a1
Atf1/Gm1862	Cit	Glrx	Lat2	Pglyrp1	Smc2
BC055004	Clic4	Gm12070/Gapdh	Lclat1	Plin2	Sypl
Bhlhe40	Cox17	Gm5068	Lgals1	Plk4	Tacc3
Bub1	Cpsf2	Gm5177	Lgals3	Plscr1	Tank
C330027C09Rik	Cpt2	Gm5523/Gapdh/Gm12070	Lilrb4	Pqlc3	Tfdp1
Casp3	Cxcl10	Gpd2	Lman2	Prdm1 (Blimp-1)	Tmem109
Casp4	Cyfp1	Gpr56	Ly6a	Ptger2	Tnfrsf1b
Ccdc50	Dock7	Gpr65	Mdfic	Ptpn13	Trim47
Ccl3	E2f8	Gzmb	Mki67	Rcn1	Txn1
Ccnb2	Ect2	Ifih1	Mx1	Rhoq/Pigf	Ube2t
Cerl2	Eea1	Irf8	Nfil3	Romo1	Vamp8
	Ell2	Isg15	Nped/Cbx6/Nptxr	Rpa2	Vmp1
			Nr4a2	Rsad2	Wbp5
12 (c)	30 (d)		11 (e)	3 (f)	0 (g)
Crem	Atf3	Parvb	2810417H13Rik	Endod1	X
Cyth3	Bst2	Parvg	Cenb1/Gm5593	Nrn1	
Ephx1	Cblb	Pes1	Cdk1	Ptprs	
Gpm6b	Cct6a	Phlda1	Figl1		
Hspa41	Cltb	Ptprij	Lag3		
Ikzf2	Dusp16	Rab27a	Mad2l1/LOC100045924		
Marcks	Dusp4	Sema7a	Nusap1/Oip5		
Nab2	Hdgf	Sle7a5	Prc1		
Prmt2	Hip1	Snx9	Rrm2		
Soat1	Hspd1	Spry1	Tnfrsf9 (4-1BB)		
Synj2	Ier3ip1/Hdhd2	Stat3	Top2a		
Ypel2	Lix11	Tatdn1/Rnf139			
	Ndufc2/LOC675851/LOC635087	Tfg			
	Nfat5	Trib1			
	Otud7b	Zc3h12c			
3 (h)	4 (i)	1 (j)	1 (k)	0 (l)	0 (m)
Itm2a	Ctla4	Tox	Rgs16	X	X
Mcm6	Gem				
Pkm	Irf4				
	Ndfip1				
0 (n)	0 (o)				
X	X				

Supplemental Table 2. Overlap between hypofunctional CD8+ T cell programs that share increased gene expression with TASP1 TIL. Overlap of genes up-regulated by hypofunctional CD8+ T cells that comprised the Leading Edge [30] of gene sets enriched among genes up-regulated by TASP1 TIL were compared for overlap by the Venn diagram in Figure 3B. An “X” indicates that no genes were in this category.

Supplemental Table 3. The molecular profile of TIL consists of 1164 differentially expressed genes between tumor-specific CD8⁺ T cells from the tumor and spleen

Cluster	Probe ID	Gene Symbol	Fold-change TIL _{tumor} / Sp _{tumor}	Gene type(s)
Cluster 01	10407072	Elovl7	-5.60	Acyltransferase
Cluster 01	10420131	Rabggta	-2.60	Acyltransferase
Cluster 01	10351197	Sell	-13.09	Adpolipoprotein, receptor, metalloprotease, serine protease, complement component, cell adhesion molecule
Cluster 01	10356880	St8sia4	-2.57	Alpha-N-acetylneuraminate alpha-2,8-sialyltransferase activity
Cluster 01	10473367	Slc43a1	-2.75	Amino acid transporter
Cluster 01	10471154	Ass1/Gm5424	-3.21	Argininosuccinate synthase
Cluster 01	10363541	Ass1/Gm5424	-3.18	Argininosuccinate synthase
Cluster 01	10549102	Kcnj8	-3.24	ATP binding, ATP-activated inward rectifier potassium channel activity
Cluster 01	10479463	Slc17a9	-2.98	Cation transporter
Cluster 01	10443764	Slc37a1	-2.28	Cation transporter
Cluster 01	10522335	Atp10d	-6.32	Cation transporter, hydrolase
Cluster 01	10468898	Lax1	-3.66	Cation transporter, hydrolase
Cluster 01	10491486	Atp11b	-2.21	Cation transporter, hydrolase
Cluster 01	10406111	Slc12a7	-3.24	Cation: chloride symporter activity
Cluster 01	10359816	Pogk	-2.15	Centromere DNA-binding protein
Cluster 01	10389207	Ccl5 (RANTES)	-3.29	Chemokine
Cluster 01	10565218	Il16	-2.45	Cytokine, interleukin superfamily
Cluster 01	10378549	Rtn4rl1	-4.79	Cytokine, receptor, extracellular matrix protein
Cluster 01	10499655	Il6ra (CD126)	-2.68	Cytokine, type I cytokine receptor, defense/immunity protein
Cluster 01	10477649	Acss2	-2.97	Dehydrogenase ligase
Cluster 01	10488482	Acss1	-2.28	Dehydrogenase ligase
Cluster 01	10387316	Chd3	-3.80	DNA helicase, helicase
Cluster 01	10503190	Chd7	-2.98	DNA helicase, helicase
Cluster 01	10377537	Chd3	-2.77	DNA helicase, helicase
Cluster 01	10494428	Txnip	-2.89	Enzyme inhibitor activity
Cluster 01	10472235	Dapl1	-5.90	Enzyme modulator
Cluster 01	10402730	Ppp1r13b	-2.68	Enzyme modulator
Cluster 01	10469867	Pnpla7	-2.28	Esterase
Cluster 01	10411235	Iqgap2	-3.14	G-protein coupled modulator
Cluster 01	10364650	Hmha1	-2.82	G-protein coupled modulator
Cluster 01	10501586	S1pr1	-38.24	G-protein coupled receptor
Cluster 01	10591494	S1pr5	-10.63	G-protein coupled receptor
Cluster 01	10422493	Gpr18	-6.35	G-protein coupled receptor
Cluster 01	10371217	S1pr4	-3.83	G-protein coupled receptor
Cluster 01	10459288	Adrb2	-3.57	G-protein coupled receptor
Cluster 01	10422496	Gpr183	-3.21	G-protein coupled receptor
Cluster 01	10411226	F2r11	-2.80	G-protein coupled receptor
Cluster 01	10590365	Vipr1	-2.64	G-protein coupled receptor, antibacterial response protein
Cluster 01	10590381	Vipr1	-2.30	G-protein coupled receptor, antibacterial response protein
Cluster 01	10606058	Cxcr3	-16.15	G-protein coupled receptor, immunoglobulin receptor superfamily, protein phosphatase, immunoglobulin superfamily cell adhesion molecule
Cluster 01	10357472	Cxcr4	-13.47	G-protein coupled receptor, immunoglobulin receptor superfamily, protein phosphatase, immunoglobulin superfamily cell adhesion molecule
Cluster 01	10590620	Ccr9	-2.13	G-protein coupled receptor, immunoglobulin receptor superfamily, protein phosphatase, immunoglobulin superfamily cell adhesion molecule
Cluster 01	10441601	Tagap	-6.81	G-protein modulator
Cluster 01	10382228	Axin2	-3.78	G-protein modulator
Cluster 01	10455259	Arhgap26	-3.57	G-protein modulator
Cluster 01	10388310	Rap1gap2	-2.50	G-protein modulator
Cluster 01	10565994	Art2b	-7.94	Glycosyltransferase
Cluster 01	10556598	Xylt1	-2.28	Glycosyltransferase
Cluster 01	10429160	St3gal1	-2.27	Glycosyltransferase
Cluster 01	10555303	Pgm211	-2.77	Glycosyltransferase, mutase
Cluster 01	10604751	Fgf13	-4.16	Growth factor
Cluster 01	10407281	Esm1	-2.11	Growth factor
Cluster 01	10460968	Rasgrp2	-13.86	Guanyl-nucleotide exchange factor
Cluster 01	10472860	Rapgef4	-2.47	Guanyl-nucleotide exchange factor
Cluster 01	10569733	Arhgef18	-5.21	Gyanyl-nucleotide exchange factor
Cluster 01	10413419	Arhgef3	-4.40	Gyanyl-nucleotide exchange factor
Cluster 01	10386951	Hs3st3b1	-2.25	Heparan sulfate-glucosamine 3-sulfotransferase 1

Cluster 01	10544150	Jhdm1d (Kdm7a)	-3.52	Histone demethylase activity (H3-K27 specific), histone demethylase activity (H3-K9 specific)
Cluster 01	10432619	Pou6f1	-2.28	Homeobox transcription factor
Cluster 01	10424213	Zhx2	-2.89	Homeobox transcription factor, nucleic acid binding
Cluster 01	10443535	Tbc1d22b	-2.27	Hydrolase, G-protein modulator
Cluster 01	10394054	Cd7	-6.66	Immunoglobulin receptor superfamily
Cluster 01	10362097	H60b	-4.10	Immunoglobulin receptor superfamily, major histocompatibility complex antigen
Cluster 01	10393408	Tmc6	-2.04	Ion channel
Cluster 01	10373542	Dgka	-5.10	Kinase
Cluster 01	10518686	Pik3cd	-2.21	Kinase
Cluster 01	10383010	Socs3	-2.25	Kinase inhibitor
Cluster 01	10362275	Samd3	-5.60	Kinase modulator
Cluster 01	10549282	Itp2	-2.52	Ligand-gated ion channel
Cluster 01	10511739	Cpne3	-2.53	Membrane traffic protein
Cluster 01	10446777	Ehd3	-2.87	Membrane traffic protein, G-protein modulator, calcium-binding protein
Cluster 01	10402142	Ccde88c	-2.79	Membrane traffic protein, kinase modulator
Cluster 01	10545608	Sema4f	-2.11	Membrane-bound signaling molecule
Cluster 01	10542120	Clec2i	-3.90	Membrane-bound signaling molecule, receptor, defense/immunity protein
Cluster 01	10380135	Mir142	-6.19	microRNA
Cluster 01	10350247	Kif21b	-3.73	Microtubule binding motor protein
Cluster 01	10566258	Hbb-b1/Hbb-b2/Beta-s	-66.23	Misc.
Cluster 01	10566254	Hbb-b1/Hbb-b2/Beta-s	-54.36	Misc.
Cluster 01	10375051	Hba-a1/Hba-a2	-27.88	Misc.
Cluster 01	10375058	Hba-a1/Hba-a2	-27.74	Misc.
Cluster 01	10497337	Car1	-24.15	Misc.
Cluster 01	10563099	Snord35b	-17.65	Misc.
Cluster 01	10404132	Cmah	-17.12	Misc.
Cluster 01	10404152	Fam65b	-14.49	Misc.
Cluster 01	10389190	Gm11435	-9.40	Misc.
Cluster 01	10533182	Dtx1/Gm19706	-7.80	Misc.
Cluster 01	10468527	5830416P10Rik	-7.34	Misc.
Cluster 01	10388488	Fam101b	-7.20	Misc.
Cluster 01	10573054	Gypa	-7.13	Misc.
Cluster 01	10570516	Kbtbd11	-6.79	Misc.
Cluster 01	10490923	Car2	-6.14	Misc.
Cluster 01	10375019	Nsg2	-6.13	Misc.
Cluster 01	10603814	Slc9a7	-6.02	Misc.
Cluster 01	10427454	Card6	-5.83	Misc.
Cluster 01	10378833	Ssh2	-5.65	Misc.
Cluster 01	10378855	Ssh2	-5.52	Misc.
Cluster 01	10570513	Kbtbd11	-5.48	Misc.
Cluster 01	10569719	A430078G23Rik	-5.46	Misc.
Cluster 01	10392910	C630004H02Rik	-5.40	Misc.
Cluster 01	10377265	Pik3r5	-5.28	Misc.
Cluster 01	10414731	10414731	-5.21	Misc.
Cluster 01	10543785	AB041803	-5.02	Misc.
Cluster 01	10367532	Tespa1	-4.92	Misc.
Cluster 01	10358717	1700025G04Rik	-4.83	Misc.
Cluster 01	10455784	Gramd3	-4.76	Misc.
Cluster 01	10501007	Chi317	-4.40	Misc.
Cluster 01	10591739	Acp5	-4.32	Misc.
Cluster 01	10531126	Igj	-4.25	Misc.
Cluster 01	10394593	Fam49a	-4.15	Misc.
Cluster 01	10382449	Rab37	-4.11	Misc.
Cluster 01	10393544	Cyth1	-3.91	Misc.
Cluster 01	10545184	10545184	-3.81	Misc.
Cluster 01	10463164	Frat1	-3.73	Misc.
Cluster 01	10587854	Slc9a9	-3.62	Misc.
Cluster 01	10356932	D1Ert622e	-3.62	Misc.
Cluster 01	10498998	D930015E06Rik	-3.53	Misc.
Cluster 01	10400137	Dnajb9	-3.31	Misc.
Cluster 01	10557481	Ypel3	-3.26	Misc.
Cluster 01	10584762	Bcl9l	-3.19	Misc.
Cluster 01	10416371	Lpar6/Rb1	-3.16	Misc.
Cluster 01	10481574	Fam78a	-3.16	Misc.
Cluster 01	10401428	C130039O16Rik (Elmsan1)	-3.14	Misc.

Cluster 01	10467650	Frat2	-3.01	Misc.
Cluster 01	10533007	Ccdc64	-3.00	Misc.
Cluster 01	10565990	Art2a-ps	-3.00	Misc.
Cluster 01	10546010	Arhgap25	-2.95	Misc.
Cluster 01	10520388	Rbm33	-2.94	Misc.
Cluster 01	10545065	Gprin3	-2.92	Misc.
Cluster 01	10397476	2310044G17Rik	-2.90	Misc.
Cluster 01	10538123	Gimap9	-2.89	Misc.
Cluster 01	10425799	Rnu12	-2.86	Misc.
Cluster 01	10530612	Fryl	-2.85	Misc.
Cluster 01	10534570	Orai2	-2.84	Misc.
Cluster 01	10568586	Fam53b	-2.84	Misc.
Cluster 01	10500100	Tnfaip812	-2.81	Misc.
Cluster 01	10379630	Slfn2	-2.78	Misc.
Cluster 01	10550365	Prkd2	-2.76	Misc.
Cluster 01	10425410	Grap2	-2.73	Misc.
Cluster 01	10497237	Pagl	-2.72	Misc.
Cluster 01	10409767	Golm1	-2.71	Misc.
Cluster 01	10430649	Cbx7	-2.70	Misc.
Cluster 01	10359303	4930562F07Rik	-2.70	Misc.
Cluster 01	10447629	Tagap1/Tagap/Fgfr1op	-2.66	Misc.
Cluster 01	10549162	St8sia1	-2.65	Misc.
Cluster 01	10406905	Ccdc125	-2.61	Misc.
Cluster 01	10436426	Orai2	-2.59	Misc.
Cluster 01	10571344	D8Ert82e (SGK223)	-2.59	Misc.
Cluster 01	10350977	4930523C07Rik/4930562F07Rik	-2.55	Misc.
Cluster 01	10530592	Fryl	-2.54	Misc.
Cluster 01	10532150	Fam69a	-2.51	Misc.
Cluster 01	10439058	Lrrc33 (Nrros)	-2.50	Misc.
Cluster 01	10566438	Fam160a2	-2.49	Misc.
Cluster 01	10440099	St3gal6/Dbld2	-2.46	Misc.
Cluster 01	10443027	A930001N09Rik	-2.45	Misc.
Cluster 01	10469695	Apbb1ip	-2.45	Misc.
Cluster 01	10458098	Pkd2l2/Fam13b	-2.44	Misc.
Cluster 01	10380514	Fam117a	-2.43	Misc.
Cluster 01	10468525	5830416P10Rik (Mirt1)	-2.43	Misc.
Cluster 01	10520043	Lhfp13	-2.42	Misc.
Cluster 01	10530563	Fryl	-2.42	Misc.
Cluster 01	10434302	Klhl24	-2.41	Misc.
Cluster 01	10358978	Ier5	-2.41	Misc.
Cluster 01	10390574	Fbxl20	-2.37	Misc.
Cluster 01	10382935	Tnrc6c	-2.36	Misc.
Cluster 01	10460787	Atg2a	-2.36	Misc.
Cluster 01	10528036	10528036	-2.35	Misc.
Cluster 01	10583669	AB124611	-2.35	Misc.
Cluster 01	10380059	Rnu3b1/Rnu3b2/Rnu3b4/Rnu3b3	-2.34	Misc.
Cluster 01	10380061	Rnu3b1/Rnu3b2/Rnu3b4/Rnu3b3	-2.34	Misc.
Cluster 01	10380063	Rnu3b1/Rnu3b2/Rnu3b4/Rnu3b3	-2.34	Misc.
Cluster 01	10380065	Rnu3b1/Rnu3b2/Rnu3b4/Rnu3b3	-2.34	Misc.
Cluster 01	10528723	Mll3 (Kmt2c)	-2.34	Misc.
Cluster 01	10426042	Gramd4	-2.34	Misc.
Cluster 01	10456719	10456719	-2.33	Misc.
Cluster 01	10591263	Fbxl12/Ubl5	-2.32	Misc.
Cluster 01	10571302	Tmem66 (Saraf)	-2.31	Misc.
Cluster 01	10358191	Camsap2	-2.31	Misc.
Cluster 01	10492826	Fbxw7/Dear1	-2.29	Misc.
Cluster 01	10524229	A630023P12Rik	-2.29	Misc.
Cluster 01	10358713	1700025G04Rik	-2.28	Misc.
Cluster 01	10441115	Brwd1	-2.28	Misc.
Cluster 01	10587012	Ccpg1	-2.27	Misc.
Cluster 01	10560202	Gltscr1	-2.26	Misc.
Cluster 01	10457022	Mbp	-2.25	Misc.
Cluster 01	10390186	Abi3/Phospho1	-2.24	Misc.
Cluster 01	10375083	Stk10	-2.24	Misc.
Cluster 01	10577230	Erich1	-2.23	Misc.
Cluster 01	10493626	1700094D03Rik	-2.22	Misc.
Cluster 01	10380477	Ppp1r9b	-2.20	Misc.
Cluster 01	10567171	Snord14a/Rps13	-2.19	Misc.
Cluster 01	10487595	10487595	-2.19	Misc.

Cluster 01	10528090	Rundc3b	-2.18	Misc.
Cluster 01	10432473	Nckap5l	-2.18	Misc.
Cluster 01	10456721	10456721	-2.18	Misc.
Cluster 01	10585905	Parp6	-2.17	Misc.
Cluster 01	10449854	Akap8l	-2.13	Misc.
Cluster 01	10426535	Fam113b/Amigo2	-2.13	Misc.
Cluster 01	10568780	Mapk1ip1	-2.10	Misc.
Cluster 01	10503484	Fam82b	-2.09	Misc.
Cluster 01	10407370	4833420G17Rik	-2.02	Misc.
Cluster 01	10439583	Sidt1	-13.82	Misc.
Cluster 01	10503259	Trp53inp1 (S1P)	-7.63	Misc.
Cluster 01	10419966	Zfhx2/Zfhx2as	-2.58	Misc.
Cluster 01	10552276	Ube2h	-2.47	Misc.
Cluster 01	10509379	Usp48	-2.46	Misc.
Cluster 01	10512480	Sit1	-2.43	Misc.
Cluster 01	10543686	Ube2h	-2.40	Misc.
Cluster 01	10383982	Znrf3	-2.25	Misc.
Cluster 01	10412038	Zswim6	-2.23	Misc.
Cluster 01	10503551	Usp45	-2.17	Misc.
Cluster 01	10378649	Slc43a2	-2.15	Misc.
Cluster 01	10506569	Usp24	-2.13	Misc.
Cluster 01	10383632	Sfi1/LOC100861749	-2.08	Misc.
Cluster 01	10494160	Tmod4	-2.17	Non-motor actin binding protein
Cluster 01	10575120	Sntb2	-2.10	Non-motor actin binding protein
Cluster 01	10357604	Ikbke	-3.05	Non-receptor serine/threonine protein kinase
Cluster 01	10420413	Lats2	-2.34	Non-receptor serine/threonine protein kinase, annexin, calmodulin
Cluster 01	10500813	Hipk1	-2.61	Non-receptor serine/threonine protein kinase, non-receptor tyrosine protein kinase
Cluster 01	10372745	Dyrk2	-2.57	Non-receptor serine/threonine protein kinase, non-receptor tyrosine protein kinase
Cluster 01	10449527	Stk38	-3.89	Non-receptor serine/threonine protein kinase, transfer/carrier protein, annexin, calmodulin
Cluster 01	10362073	Sgk1	-3.51	Non-receptor serine/threonine protein kinase, transfer/carrier protein, annexin, calmodulin
Cluster 01	10479852	Camk1d	-2.20	Non-receptor serine/threonine protein kinase
Cluster 01	10362596	Fyn	-2.68	Non-receptor tyrosine kinase
Cluster 01	10381082	Rara	-2.40	Nuclear hormone receptor
Cluster 01	10417734	Nr1d2	-4.49	Nuclear hormone receptor, receptor, nucleic acid binding
Cluster 01	10385776	Tcf7	-20.02	Nucleic acid binding
Cluster 01	10496091	Lef1	-7.64	Nucleic acid binding
Cluster 01	10505911	Dmrta1	-2.91	Nucleic acid binding
Cluster 01	10422321	Dzip1	-2.66	Nucleic acid binding
Cluster 01	10443063	Phf1	-2.60	Nucleic acid binding
Cluster 01	10401454	Entpd5	-2.14	Nucleotide phosphatase, lyase, nucleic acid binding
Cluster 01	10506786	Zcchc11	-2.50	Nucleotidyltransferase
Cluster 01	10350697	Nmnat2	-2.25	Nucleotidyltransferase
Cluster 01	10364460	Gzmm	-6.69	Peptide hormone, receptor, serine protease, protease inhibitor, annexin, calmodulin
Cluster 01	10373740	Pik3ip1	-3.82	Peptide hormone, receptor, serine protease, protease inhibitor, annexin, calmodulin
Cluster 01	10362811	Sesn1	-2.81	Peroxidase
Cluster 01	10555510	Pde2a	-15.99	Phosphodiesterase
Cluster 01	10497399	Pde7a	-2.80	Phosphodiesterase
Cluster 01	10360173	Slamf7	-3.21	Protein kinase, membrane-bound signaling molecule, immunoglobulin receptor superfamily, cell adhesion molecule
Cluster 01	10360158	Ly9 (CD229)	-2.82	Protein kinase, membrane-bound signaling molecule, immunoglobulin receptor superfamily, cell adhesion molecule
Cluster 01	10357191	Ptpn4	-2.44	Protein phosphatase
Cluster 01	10563338	Ppp1r15a	-2.60	protein phosphatase binding, protein phosphatase regulator activity
Cluster 01	10484941	Madd	-2.53	Rab guanyl-nucleotide exchange factor activity
Cluster 01	10362896	Cd24a	-27.60	Receptor
Cluster 01	10365344	Tcp1l12	-8.00	Receptor
Cluster 01	10557895	Itgax (CD11c)	-5.12	Receptor
Cluster 01	10541246	Il17ra (CD217)	-3.74	Receptor
Cluster 01	10473125	Itega4 (CD49d)	-2.65	Receptor
Cluster 01	10432957	Iteb7 (Ly69)	-4.43	Receptor, extracellular matrix glycoprotein, cell adhesion molecule
Cluster 01	10530145	Tlr1	-5.65	Receptor, extracellular matrix protein
Cluster 01	10374560	Zrsr1	-2.62	Ribonucleoprotein

Cluster 01	10453272	Zfp3612	-3.15	RNA binding protein
Cluster 01	10561453	Zfp36	-2.53	RNA binding protein
Cluster 01	10401238	Zfp3611	-2.40	RNA binding protein
Cluster 01	10412211	Gzma	-8.46	Serine protease
Cluster 01	10598467	Pim2	-2.54	Serine/threonine protein kinase receptor, protein kinase
Cluster 01	10517301	Ldlrap1	-2.49	Signaling molecule
Cluster 01	10577190	Rasa3	-7.61	Signaling molecule, G-protein modulator
Cluster 01	10415725	Spata13	-2.49	Signaling molecule, guanyl-nucleotide exchange factor
Cluster 01	10392177	Icam2	-2.88	Signaling molecule, immunoglobulin superfamily cell adhesion molecule
Cluster 01	10380381	Tob1	-3.22	SMAD binding, transcription corepressor activity
Cluster 01	10390535	Arl5c	-7.19	Small GTPase
Cluster 01	10356475	Arl4c	-4.50	Small GTPase
Cluster 01	10567043	Rras2	-2.12	Small GTPase
Cluster 01	10411126	Jmy	-3.12	Transcription coactivator activity
Cluster 01	10365428	Btdb11	-2.11	Transcription cofactor, growth factor, serine protease, non-motor actin binding protein
Cluster 01	10544891	Nod1	-5.20	Transcription cofactor, nucleic acid binding
Cluster 01	10474006	Phf21a	-2.81	Transcription cofactor, ubiquitin-protein ligase
Cluster 01	10594404	Smad3	-4.40	Transcription factor
Cluster 01	10354111	Aff3	-4.19	Transcription factor
Cluster 01	10583207	Maml2	-3.10	Transcription factor
Cluster 01	10598101	Maml2	-2.73	Transcription factor
Cluster 01	10466865	Rfx3	-2.52	Transcription factor
Cluster 01	10489961	Nfate2	-2.36	Transcription factor
Cluster 01	10574962	Nfate3	-2.26	Transcription factor
Cluster 01	10606989	Tsc22d3	-2.24	Transcription factor
Cluster 01	10362861	Scml4	-3.52	Transcription factor, chromatin/chromatin-binding protein
Cluster 01	10467420	Pdlim1	-2.82	Transcription factor, non-motor actin binding protein
Cluster 01	10520950	Pdlim1	-2.44	Transcription factor, non-motor actin binding protein
Cluster 01	10522051	Klf3 (Bklf)	-8.67	Transcription factor, nucleic acid binding
Cluster 01	10572800	Klf2 (Lklf)	-4.64	Transcription factor, nucleic acid binding
Cluster 01	10546661	Foxp1	-3.49	Transcription factor, nucleic acid binding
Cluster 01	10530142	Klf3 (Bklf)	-2.59	Transcription factor, nucleic acid binding
Cluster 01	10557488	Tbx6	-2.51	Transcription factor, nucleic acid binding
Cluster 01	10397346	Fos	-2.41	Transcription factor, nucleic acid binding
Cluster 01	10589994	Eomes	-2.17	Transcription factor, nucleic acid binding
Cluster 01	10441003	Runx1	-2.09	Transcription factor, nucleic acid binding
Cluster 01	10438445	Klhl6	-5.33	Transcription factor, serine protease, non-motor actin binding protein
Cluster 01	10594001	Arid3b	-2.71	Transcription regulator
Cluster 01	10396205	Arid4a	-2.18	Transcription regulator
Cluster 01	10481103	Len4	-2.25	Transfer/carrier protein, isomerase
Cluster 01	10524345	Tpst2	-2.87	Transferase
Cluster 01	10547513	Cecl5	-2.18	Transferase
Cluster 01	10463997	Pdcd4	-2.79	Translation elongation factor
Cluster 01	10407327	Emb	-16.65	Transmembrane receptor regulatory/adaptor protein
Cluster 01	10605357	Gab3	-4.64	Transmembrane receptor regulatory/adaptor protein
Cluster 01	10412376	Emb	-3.92	Transmembrane receptor regulatory/adaptor protein
Cluster 01	10558410	Ptpre	-2.24	Transmembrane receptor regulatory/adaptor protein, receptor, protein phosphatase
Cluster 01	10564631	Slco3a1	-6.08	Transporter
Cluster 01	10391649	Slc4a1	-4.53	Transporter
Cluster 01	10439239	Dir2	-3.11	Transporter
Cluster 01	10382532	Slc16a5	-2.41	Transporter
Cluster 01	10569485	Tnfrsf26	-8.06	Tumor necrosis factor receptor
Cluster 01	10427628	Il7r (CD127)	-5.74	Type I cytokine receptor
Cluster 01	10436830	Ifnar2	-2.43	Type I cytokine receptor, type II cytokine receptor
Cluster 01	10351691	Slamf6	-17.97	Tyrosine protein kinase receptor, membrane-bound signaling molecule, immunoglobulin receptor superfamily, tyrosine protein kinase receptor, protein kinase, immunoglobulin receptor superfamily, cell adhesion molecule
Cluster 01	10404874	Mylip	-3.40	Ubiquitin protein ligase activity, ubiquitin-protein transferase activity
Cluster 01	10374485	Peli1	-2.53	Ubiquitin protein ligase activity, ubiquitin-protein transferase activity
Cluster 01	10454202	Rnfl38	-3.11	Ubiquitin-protein ligase
Cluster 01	10501879	Usp53	-2.36	Ubiquitin-protein ligase
Cluster 01	10511755	Wwp1	-2.15	Ubiquitin-protein ligase

Cluster 01	10580452	Siah1a	-2.23	Ubiquitin-protein transferase activity, zinc ion binding
Cluster 01	10350046	Kdm5b	-2.40	Zinc finger transcription factor
Cluster 01	10479159	Zfp831	-3.29	Zinc finger transcription factor, nucleic acid binding
Cluster 01	10402554	Bcl11b	-2.85	Zinc finger transcription factor, nucleic acid binding
Cluster 01	10361338	Ipcf1	-2.72	
Cluster 02 & 03	10560304	Calm1/Calm2/Calm3	2.09	Calmodulin
Cluster 02 & 03	10461452	Fen1	2.02	Damaged DNA-binding protein, endodeoxyribonuclease, exodeoxyribonuclease, nuclease, hydrolase
Cluster 02 & 03	10389395	Brip1	3.88	DNA helicase, helicase
Cluster 02 & 03	10510687	Acot7 (Bach)	2.80	Esterase
Cluster 02 & 03	10452648	Emilin2	3.08	Extracellular matrix glycoprotein
Cluster 02 & 03	10540298	Chl1	2.55	G-protein coupled receptor, immunoglobulin receptor superfamily, protein phosphatase, immunoglobulin superfamily cell adhesion molecule
Cluster 02 & 03	10485963	Arhgap11a	3.60	G-protein modulator
Cluster 02 & 03	10584710	H2afx	2.42	Histone
Cluster 02 & 03	10520521	Cenpa	2.79	Histone
Cluster 02 & 03	10600017	Hmgb3	2.03	HMG-box transcription factor, signaling molecule, chromatin/chromatin-binding protein
Cluster 02 & 03	10352954	Hmgb3	2.28	HMG-box transcription factor, signaling molecule, chromatin/chromatin-binding protein
Cluster 02 & 03	10497689	Gnb4	2.09	Hydrolase, heterotrimeric G-protein
Cluster 02 & 03	10441436	Snx9	8.06	Membrane trafficking regulatory protein
Cluster 02 & 03	10585331	Expf5	2.00	Misc.
Cluster 02 & 03	10439881	5330426P16Rik	2.08	Misc.
Cluster 02 & 03	10469505	Commd3	2.14	Misc.
Cluster 02 & 03	10503617	Mms22l	2.18	Misc.
Cluster 02 & 03	10420730	Fdft1/Ctsb	2.20	Misc.
Cluster 02 & 03	10416155	Kctd9	2.22	Misc.
Cluster 02 & 03	10515090	Cdkn2c	2.27	Misc.
Cluster 02 & 03	10412909	Fdft1	2.28	Misc.
Cluster 02 & 03	10588482	Poc1a	2.29	Misc.
Cluster 02 & 03	10380289	Mmd	2.35	Misc.
Cluster 02 & 03	10605431	Rab39b	2.39	Misc.
Cluster 02 & 03	10345074	Cetn4	2.55	Misc.
Cluster 02 & 03	10465861	Incenp	2.56	Misc.
Cluster 02 & 03	10404380	Dusp22	2.66	Misc.
Cluster 02 & 03	10575733	Cenpn	2.93	Misc.
Cluster 02 & 03	10403413	Idi1/Gm13502	2.94	Misc.
Cluster 02 & 03	10548086	Rad51ap1	2.96	Misc.
Cluster 02 & 03	10560695	Ceacam16	3.02	Misc.
Cluster 02 & 03	10482762	Idi1/Gm13502	3.04	Misc.
Cluster 02 & 03	10482528	Neb	3.45	Misc.
Cluster 02 & 03	10414315	Cdkn3	3.46	Misc.
Cluster 02 & 03	10474825	D2Ert750e	3.48	Misc.
Cluster 02 & 03	10505299	Bspry	3.76	Misc.
Cluster 02 & 03	10608686	10608686	4.99	Misc.
Cluster 02 & 03	10360985	Cenpf	5.21	Misc.
Cluster 02 & 03	10538356	Chn2/9130019P16Rik	5.68	Misc.
Cluster 02 & 03	10442219	Zfp52	2.08	Misc.
Cluster 02 & 03	10534301	Syna	3.36	Misc.
Cluster 02 & 03	10511363	Penk	9.61	Neuropeptide
Cluster 02 & 03	10480432	Mastl	6.11	Non-receptor serine/threonine protein kinase, transfer/carrier protein, calmodulin
Cluster 02 & 03	10544106	Zc3hav1	2.11	Nucleic acid binding
Cluster 02 & 03	10563323	Nucb1	2.35	Nucleic acid binding, annexin, calmodulin
Cluster 02 & 03	10456383	Impa2	3.85	Phosphatase
Cluster 02 & 03	10513158	Ptpn3	4.00	Protein phosphatase
Cluster 02 & 03	10563685	Ptpn5	4.31	Protein phosphatase
Cluster 02 & 03	10557156	Plk1	3.88	Protein serine/threonine kinase activity
Cluster 02 & 03	10503098	Lyn/Gm11787	4.56	Protein tyrosine kinase activity
Cluster 02 & 03	10547906	Lag3 (CD223)	4.96	Transmembrane signaling receptor activity, MHC class II protein binding
Cluster 02 & 04	10396421	Hif1a	2.11	Basic helix-loop-helix transcription factor, nucleic acid binding
Cluster 02 & 04	10531724	Plac8	2.66	Chromatin binding
Cluster 02 & 04	10477052	Slc52a3	2.08	G-protein coupled receptor
Cluster 02 & 04	10421517	Cysltr2	2.49	G-protein coupled receptor
Cluster 02 & 04	10414271	Ptger2	2.85	G-protein coupled receptor

Cluster 02 & 04	10597279	Ccr12	4.77	G-protein coupled receptor, immunoglobulin receptor superfamily, protein phosphatase, immunoglobulin superfamily cell adhesion molecule
Cluster 02 & 04	10411332	Hmger	2.03	Hydroxymethylglutaryl-CoA reductase (NADPH)
Cluster 02 & 04	10441195	Dscam	3.55	Immunoglobulin receptor superfamily, protein phosphatase, immunoglobulin receptor superfamily cell adhesion molecule
Cluster 02 & 04	10548532	Klra5/Klra9/Klra19	3.26	Membrane-bound signaling molecule, receptor, defense/immunity protein
Cluster 02 & 04	10548450	Klra5	4.17	Membrane-bound signaling molecule, receptor, defense/immunity protein
Cluster 02 & 04	10406982	Adams6	2.97	Metalloprotease, extracellular matrix glycoprotein, serine protease inhibitor
Cluster 02 & 04	10398039	Serpina3f/Serpina3g	2.07	Misc.
Cluster 02 & 04	10523923	Ccdc18	2.09	Misc.
Cluster 02 & 04	10461553	A430093F15Rik	2.28	Misc.
Cluster 02 & 04	10446229	Tnfsf9	2.64	Misc.
Cluster 02 & 04	10447341	Rhoq/Pigf	2.98	Misc.
Cluster 02 & 04	10502791	Ifi44	3.32	Misc.
Cluster 02 & 04	10558090	Tacc2	2.00	Misc.
Cluster 02 & 04	10548573	Styk1	2.84	Non-receptor tyrosine protein kinase
Cluster 02 & 04	10513145	Ptpn3	2.16	Protein phosphatase
Cluster 02 & 04	10513164	Ptpn3	2.35	Protein phosphatase
Cluster 02 & 04	10513166	Ptpn3	2.74	Protein phosphatase
Cluster 02 & 04	10513162	Ptpn3	2.74	Protein phosphatase
Cluster 02 & 04	10346790	Ctla4 (CD152)	2.48	Receptor
Cluster 02 & 04	10381809	Itgb3 (CD61)	2.40	Receptor, extracellular matrix glycoprotein, cell adhesion molecule
Cluster 02 & 04	10511290	Tnfrsf18	2.26	Tumor necrosis factor receptor
Cluster 02 & 04	10469278	Il2ra (CD25)	5.32	Type I cytokine receptor
Cluster 02 & 05	10495405	Slc25a24	3.50	Amino acid transporter, mitochondrial carrier protein, transfer/carrier protein, ribosomal protein, calmodulin
Cluster 02 & 05	10606436	Hmgn5	2.22	Chromatin/chromatin-binding protein
Cluster 02 & 05	10419296	Wdhd1	2.12	DNA binding protein
Cluster 02 & 05	10578690	Neil3	3.97	DNA glycosylase, damaged DNA-binding protein, endodeoxyribonuclease, nuclease, lyase, esterase, glycosidase
Cluster 02 & 05	10546163	Mcm2	2.58	DNA helicase, hydrolase
Cluster 02 & 05	10550102	Lig1	3.30	DNA ligase
Cluster 02 & 05	10568050	Aldoa/Aldoat1	2.40	Fructose-bisphosphate aldolase
Cluster 02 & 05	10587107	Myo5a	2.76	G-protein coupled modulator, actin binding motor protein, cell junction protein
Cluster 02 & 05	10397645	Gpr65	2.10	G-protein coupled receptor
Cluster 02 & 05	10362294	Arhgap18	2.06	G-protein modulator
Cluster 02 & 05	10482059	Ggta1	2.84	Glycosyltransferase
Cluster 02 & 05	10462973	Hells (LSH)	3.74	Helicase
Cluster 02 & 05	10511416	Tox	4.29	HMG box transcription factor, signaling molecule, chromatin/chromatin-binding protein
Cluster 02 & 05	10491780	Hspa41	2.59	Hsp70 family chaperone
Cluster 02 & 05	10472212	Pkp4	2.68	Intermediate filament binding protein
Cluster 02 & 05	10459481	Lman1	3.17	Membrane traffic protein
Cluster 02 & 05	10486396	Ehd4	4.27	Membrane traffic protein, G-protein modulator, calcium-binding protein
Cluster 02 & 05	10559261	Cd81	5.98	Membrane-bound signaling molecule, receptor, cell adhesion molecule
Cluster 02 & 05	10594251	Kif23	2.76	Microtubule binding motor protein
Cluster 02 & 05	10353733	Prim2	2.22	Misc.
Cluster 02 & 05	10580771	Ciapin1	2.30	Misc.
Cluster 02 & 05	10400189	10400189	2.31	Misc.
Cluster 02 & 05	10361760	Timm8a1	2.36	Misc.
Cluster 02 & 05	10606689	Timm8a1	2.37	Misc.
Cluster 02 & 05	10474437	Ccdc34	2.45	Misc.
Cluster 02 & 05	10556640	6330503K22Rik (Ccp110)	2.55	Misc.
Cluster 02 & 05	10548585	Csda	2.60	Misc.
Cluster 02 & 05	10544644	Dfna5	2.88	Misc.
Cluster 02 & 05	10479811	Mcm10	2.97	Misc.
Cluster 02 & 05	10365933	Eea1	3.07	Misc.
Cluster 02 & 05	10409990	6720489N17Rik	3.20	Misc.
Cluster 02 & 05	10503315	Rad54b/Fsbp	3.28	Misc.
Cluster 02 & 05	10452709	Ndc80	3.35	Misc.
Cluster 02 & 05	10554325	5730590G19Rik	3.36	Misc.
Cluster 02 & 05	10455967	2610318N02Rik	3.44	Misc.
Cluster 02 & 05	10499035	Mnd1/Gm3833	3.46	Misc.

Cluster 02 & 05	10352756	Lpgat1	3.80	Misc.
Cluster 02 & 05	10483401	Spe25	4.05	Misc.
Cluster 02 & 05	10524169	Pole	4.23	Misc.
Cluster 02 & 05	10497520	Ect2	5.18	Misc.
Cluster 02 & 05	10408600	Serpinb6a	6.27	Misc.
Cluster 02 & 05	10424221	Wdr67 (Tbc1d31)	3.15	Misc.
Cluster 02 & 05	10466410	Psat1/LOC100047252	4.62	Misc.
Cluster 02 & 05	10412562	Flnb	2.44	Non-motor actin binding protein
Cluster 02 & 05	10421877	Diap3	4.90	Non-motor actin binding protein
Cluster 02 & 05	10473919	Ckap5	2.21	Non-motor microtubule binding protein
Cluster 02 & 05	10557459	Mapk3	2.57	Non-receptor serine/theronine protein kinase
Cluster 02 & 05	10452980	Eif2ak2	2.70	Non-receptor serine/theronine protein kinase
Cluster 02 & 05	10524790	Cit	2.96	Non-receptor serine/theronine protein kinase
Cluster 02 & 05	10588243	Ryk	3.62	NOT protein tyrosine kinase activity
Cluster 02 & 05	10582809	Tk1	2.50	Nucleotide kinase
Cluster 02 & 05	10538253	Mpp6	3.02	Nucleotide kinase, cell junction protein
Cluster 02 & 05	10371888	Tmpo	2.05	Peptide hormone
Cluster 02 & 05	10578703	Spcs3	2.51	Protease
Cluster 02 & 05	10458195	Cdc25c	4.13	Protein phosphatase
Cluster 02 & 05	10439895	Alcam (CD166)	2.68	Receptor, immunoglobulin superfamily cell adhesion molecule
Cluster 02 & 05	10428672	Dscc1	4.00	Replication origin binding protein
Cluster 02 & 05	10438378	Cdc45	4.26	Replication origin binding protein
Cluster 02 & 05	10601854	Wbp5	2.41	Transcription factor
Cluster 02 & 05	10408477	E2f3	2.16	Transcription factor, nucleic acid binding
Cluster 02 & 05	10570373	Tfdp1	2.35	Transcription factor, nucleic acid binding
Cluster 02 & 05	10355246	Acadl	2.67	Transferase dehydrogenase oxidase
Cluster 02 & 05	10592058	Tuba1b	2.06	Tubulin
Cluster 02 & 05	10581800	Rfwd3	2.04	Ubiquitin-protein ligase
Cluster 02 & 05	10568461	Rfwd3	2.08	Ubiquitin-protein ligase
Cluster 02 & 05	10428534	Trps1	3.70	Zinc finger transcription factor, nuclease
Cluster 02 & 06	10468992	Frmk4a	3.25	Actin family cytoskeletal protein
Cluster 02 & 06	10379535	Ccl8	10.85	Chemokine
Cluster 02 & 06	10515744	Cdc20	2.79	Enzyme modulator
Cluster 02 & 06	10436169	Ift57	2.34	Enzyme modulator, cytoskeletal protein
Cluster 02 & 06	10445293	Pla2g7	4.98	Esterase
Cluster 02 & 06	10449000	Msln	3.12	Extracellular matrix glycoprotein
Cluster 02 & 06	10597413	Crtap	2.84	Extracellular matrix protein
Cluster 02 & 06	10460108	Gnpat1	2.40	Glucosamine 6-phosphate N-acetyltransferase
Cluster 02 & 06	10547807	Eno2	2.64	Lyase
Cluster 02 & 06	10548030	Cd9	4.32	Membrane-bound signaling molecule, receptor, cell adhesion molecule
Cluster 02 & 06	10474381	Kif18a	2.71	Microtubule binding motor protein
Cluster 02 & 06	10548422	Klri2	5.84	Microtubule binding motor protein
Cluster 02 & 06	10515943	Ctps	2.36	Misc.
Cluster 02 & 06	10600797	Apoo/Apoo-ps	2.40	Misc.
Cluster 02 & 06	10381445	Tmem106a	2.51	Misc.
Cluster 02 & 06	10429387	Ptplb (Hacd2)	2.51	Misc.
Cluster 02 & 06	10365716	Ikbip/LOC100862563	2.52	Misc.
Cluster 02 & 06	10453715	Rab18	2.54	Misc.
Cluster 02 & 06	10383479	Hmga1/Hmga1-rs1	2.58	Misc.
Cluster 02 & 06	10582241	Zcchc14	2.61	Misc.
Cluster 02 & 06	10394735	Pdia6	2.62	Misc.
Cluster 02 & 06	10499366	Pmf1	2.65	Misc.
Cluster 02 & 06	10523529	Cops4	2.67	Misc.
Cluster 02 & 06	10582020	Gesh	2.75	Misc.
Cluster 02 & 06	10412036	Apoo/Apoo-ps	2.75	Misc.
Cluster 02 & 06	10443009	Ergic1	3.02	Misc.
Cluster 02 & 06	10538269	Dfna5	3.02	Misc.
Cluster 02 & 06	10455873	Slc12a2	3.03	Misc.
Cluster 02 & 06	10602068	Mid2	3.27	Misc.
Cluster 02 & 06	10506680	Tmem48 (Ndc1)	3.38	Misc.
Cluster 02 & 06	10381588	Gm	4.37	Misc.
Cluster 02 & 06	10498584	Rarres1	4.39	Misc.
Cluster 02 & 06	10494445	Lix1l	4.43	Misc.
Cluster 02 & 06	10430358	C1qtnf6	4.48	Misc.
Cluster 02 & 06	10487011	Gatm	6.36	Misc.
Cluster 02 & 06	10379727	Gm11428	7.76	Misc.
Cluster 02 & 06	10403821	10403821	18.40	Misc.
Cluster 02 & 06	10407940	Trgv2	26.65	Misc.

Cluster 02 & 06	10605437	Pls3	3.73	Non-motor actin binding protein
Cluster 02 & 06	10523468	Bmp2k	2.52	Non-receptor serine/threonine protein kinase
Cluster 02 & 06	10430255	Foxred2	4.83	Oxygenase
Cluster 02 & 06	10521709	Lap3	3.02	Peptidase
Cluster 02 & 06	10526520	Plod3/Znhit1	2.56	Procollagen glucosyltransferase activity, procollagen-lysine 5-dioxygenase activity
Cluster 02 & 06	10605711	Pdk3	2.39	Protein kinase
Cluster 02 & 06	10592515	Ubash3b	2.83	Protein tyrosine phosphatase activity
Cluster 02 & 06	10363498	Ppa1	2.77	Pyrophosphatase
Cluster 02 & 06	10544596	Tmem176b	5.69	Receptor
Cluster 02 & 06	10587554	Tpbg	4.84	Receptor, extracellular matrix protein
Cluster 02 & 06	10541034	Zfand4	2.72	Ribosomal protein
Cluster 02 & 06	10423654	Osr2	2.79	RNA polymerase II regulatory region sequence-specific DNA binding, sequence-specific DNA binding, transcriptional activator activity, RNA polymerase II transcription regulatory region sequence-specific binding
Cluster 02 & 06	10431424	Plxnb2	2.91	Semaphorin receptor activity
Cluster 02 & 06	10420280	Gzmg	9.91	Serine protease
Cluster 02 & 06	10420268	Gzmd/Gzme	31.46	Serine protease
Cluster 02 & 06	10550650	Ercc1/Cd3eap	2.55	TFIID-class transcription factor binding
Cluster 02 & 06	10361007	Smyd2	2.86	Transcription factor
Cluster 02 & 06	10373313	Nab2	2.51	Transcription factor binding
Cluster 02 & 06	10406934	Etv1	3.79	Transcription factor, signaling molecule, nucleic acid binding
Cluster 02 & 06	10547100	Plxnd1	3.63	Tyrosine protein kinase receptor, signaling molecule, protein kinase
Cluster 02 & 07	10464128	Casp7	2.04	Cysteine protease, protease inhibitor
Cluster 02 & 07	10353420	Mem3	2.92	DNA helicase, hydrolase
Cluster 02 & 07	10390707	Top2a	5.43	DNA topoisomerase, isomerase, enzyme modulator
Cluster 02 & 07	10542079	Foxm1/4933413G19Rik	4.56	DNA-binding protein
Cluster 02 & 07	10501699	Agl	2.66	Glycosyltransferase, glycosidase
Cluster 02 & 07	10587023	Rab27a	2.15	GTP binding, GTPase activity
Cluster 02 & 07	10562637	Ccnb1/Gm5593	4.44	Kinase
Cluster 02 & 07	10515836	Ccnb1/Gm5593	4.62	Kinase
Cluster 02 & 07	10411739	Ccnb1/Gm5593	4.67	Kinase
Cluster 02 & 07	10543067	Asns	5.26	Ligase
Cluster 02 & 07	10474984	Nusap1/Oip5	4.85	Microtubule binding
Cluster 02 & 07	10350297	Kif14	3.11	Microtubule binding motor protein
Cluster 02 & 07	10462632	Kif20b	3.15	Microtubule binding motor protein
Cluster 02 & 07	10568150	Kif22	3.67	Microtubule binding motor protein
Cluster 02 & 07	10391811	Kif18b	3.81	Microtubule binding motor protein
Cluster 02 & 07	10515431	Kif2c	5.20	Microtubule binding motor protein
Cluster 02 & 07	10496204	Cenpe	5.94	Microtubule binding motor protein
Cluster 02 & 07	10590494	Kif15	8.33	Microtubule binding motor protein
Cluster 02 & 07	10561706	2200002D01Rik (H2RSP) /Yif1b	2.02	Misc.
Cluster 02 & 07	10389134	Slfn9	2.03	Misc.
Cluster 02 & 07	10355115	Prelid1	2.14	Misc.
Cluster 02 & 07	10402650	Cinp/LOC640972	2.18	Misc.
Cluster 02 & 07	10457729	Dsc1/Tpi1	2.21	Misc.
Cluster 02 & 07	10489078	Dsn1	2.21	Misc.
Cluster 02 & 07	10430825	Cenpm	2.30	Misc.
Cluster 02 & 07	10511617	Fam92a	2.44	Misc.
Cluster 02 & 07	10484425	2700094K13Rik	2.59	Misc.
Cluster 02 & 07	10426098	Creld2	2.60	Misc.
Cluster 02 & 07	10426016	Gtse1	2.63	Misc.
Cluster 02 & 07	10593483	Fdx1	2.68	Misc.
Cluster 02 & 07	10367282	Cnpy2	2.68	Misc.
Cluster 02 & 07	10548699	10548699	2.96	Misc.
Cluster 02 & 07	10355327	Bard1	2.98	Misc.
Cluster 02 & 07	10538832	Mad2l1/LOC100045924	3.27	Misc.
Cluster 02 & 07	10406968	Cenpk/Ppwd1	3.81	Misc.
Cluster 02 & 07	10446027	Chaf1a/Ubxn6	3.83	Misc.
Cluster 02 & 07	10379127	Spag5	4.25	Misc.
Cluster 02 & 07	10541729	Cdca3	4.40	Misc.
Cluster 02 & 07	10400589	Mis18bp1	4.49	Misc.
Cluster 02 & 07	10507112	Stil	4.64	Misc.
Cluster 02 & 07	10591556	Spe24	4.69	Misc.
Cluster 02 & 07	10577508	Ckap2	5.17	Misc.
Cluster 02 & 07	10487340	Ncaph	5.41	Misc.
Cluster 02 & 07	10501229	Gstm1	5.52	Misc.

Cluster 02 & 07	10474875	Case5	5.57	Misc.
Cluster 02 & 07	10521731	Ncapg	5.93	Misc.
Cluster 02 & 07	10399087	Ncapg2	6.11	Misc.
Cluster 02 & 07	10474769	Bub1b	6.58	Misc.
Cluster 02 & 07	10350838	2810417H13Rik	6.70	Misc.
Cluster 02 & 07	10385248	Hmmr	6.76	Misc.
Cluster 02 & 07	10411728	Cenph	6.77	Misc.
Cluster 02 & 07	10487480	Bub1	10.75	Misc.
Cluster 02 & 07	10353032	Vcpip1	2.20	Misc.
Cluster 02 & 07	10528915	Tyms/Tyms-ps	2.97	Misc.
Cluster 02 & 07	10459755	Ska1	3.12	Misc.
Cluster 02 & 07	10451805	Sgol1	3.38	Misc.
Cluster 02 & 07	10521090	Tacc3	4.24	Misc.
Cluster 02 & 07	10346365	Sgol2	5.25	Misc.
Cluster 02 & 07	10554445	Prc1	3.57	Non-motor actin binding protein
Cluster 02 & 07	10350392	Aspm	4.89	Non-motor actin binding protein
Cluster 02 & 07	10477187	Tpx2	6.58	Non-motor microtubule binding protein
Cluster 02 & 07	10561854	Tbcb	2.62	Non-motor microtubule binding protein, chaperone
Cluster 02 & 07	10490104	Aurka	2.55	Non-receptor serine/theronine protein kinase
Cluster 02 & 07	10504470	Melk	3.61	Non-receptor serine/theronine protein kinase
Cluster 02 & 07	10377405	Aurkb	5.33	Non-receptor serine/theronine protein kinase
Cluster 02 & 07	10581813	Mkl1	4.33	Non-receptor serine/theronine protein kinase, non-receptor tyrosine protein kinase
Cluster 02 & 07	10369815	Cdk1	4.83	Non-receptor serine/theronine protein kinase, non-receptor tyrosine protein kinase
Cluster 02 & 07	10356859	Dtymk	2.08	Nucleotide kinase
Cluster 02 & 07	10533090	Rfc5	2.27	Nucleotidyltransferase, DNA-directed DNA polymerase
Cluster 02 & 07	10571399	Zdhhc2	4.51	Palmitoyltransferase activity
Cluster 02 & 07	10607475	Prdx4	4.59	Peroxidase
Cluster 02 & 07	10516956	Smpd13b	2.01	Phosphodiesterase
Cluster 02 & 07	10453214	Nutf2/Nutf2-ps1	2.66	Protein transporter activity
Cluster 02 & 07	10457463	Nutf2/Nutf2-ps1	2.71	Protein transporter activity
Cluster 02 & 07	10468531	Nutf2/Nutf2-ps1	2.71	Protein transporter activity
Cluster 02 & 07	10428690	Mrpl13	2.14	Ribosomal protein
Cluster 02 & 07	10346651	Bmpr2	2.39	Serine/theronine protein kinase, TGF-beta receptor, protein kinase
Cluster 02 & 07	10576883	Shebp1	6.49	SH2 domain binding
Cluster 02 & 07	10493812	S100a4	2.17	Signaling molecule, calmodulin
Cluster 02 & 07	10550509	Pglyrp1	2.46	Signaling molecule, defense/immunity protein
Cluster 02 & 07	10369252	Sept10	2.51	Small GTPase, cytoskeletal protein
Cluster 02 & 07	10359890	Nuf2	8.21	Structural protein
Cluster 02 & 07	10363901	Etv5	2.44	Transcription factor, signaling molecule, nucleic acid binding
Cluster 02 & 07	10392284	Kpna2	2.88	Transfer/carrier protein
Cluster 02 & 07	10453512	Kpna2	2.92	Transfer/carrier protein
Cluster 02 & 07	10497503	Kpna2	3.12	Transfer/carrier protein
Cluster 02 & 07	10595664	Tmed3	2.31	Transfer/carrier protein, vesicle coat protein
Cluster 02 & 07	10469035	Sephs1	2.40	Transferase
Cluster 02 & 07	10419323	Dlgap5	4.06	Ttransmembrane receptor regulatory/adaptor protein
Cluster 02 & 07	10534660	Ap1s1	2.62	Vesicle coat protein
Cluster 02 & 08	10472782	Hat1	2.21	Acetyltransferase
Cluster 02 & 08	10551614	Ech1	2.39	Acetyltransferase, acyltransferase, dehydrogenase, hydratase, ligase, epimerase/racemase
Cluster 02 & 08	10594911	Tex9	2.55	Actin binding motor protein
Cluster 02 & 08	10363475	Prfl	3.42	Apolipoprotein, receptor, metalloprotease, serine protease, metalloprotease, serine protease, complement component cell adhesion molecule
Cluster 02 & 08	10497894	Cetn4	2.15	Calcium ion binding, heterotrimeric G-protein binding
Cluster 02 & 08	10601390	Pgk1	3.80	Carbohydrate kinase
Cluster 02 & 08	10399379	Pgk1	3.83	Carbohydrate kinase
Cluster 02 & 08	10498313	Pgk1	3.83	Carbohydrate kinase
Cluster 02 & 08	10399391	Gen1	3.37	Damaged DNA-binding protein, endodeoxyribonuclease
Cluster 02 & 08	10562044	Zbtb32 (PLZP)	8.95	DNA binding, transcription corepressor activity, zinc ion binding
Cluster 02 & 08	10357436	Mcm6	2.66	DNA helicase, hydrolase
Cluster 02 & 08	10483249	Galnt3	7.43	Glycosyltransferase
Cluster 02 & 08	10408083	Hist1h3i/Hist1h3a/Hist1h3h/Hist1h3g/Hist1h3d/Hist2h3b/Hist1h3e/Hist1h3b/Hist1h3c/Hist1h3f/Hist2h3c2/Hist2h3c1	2.23	Histone
Cluster 02 & 08	10408202	Hist1h3e/Hist2h3b/Hist1h3b/Hist1h3d/Hist1h3c/Hist1h3f/Hist2h3c2/Hist2h3c1/Hist1h3h/Hist1h3a/Hist1h3i/Hist1h3g	2.26	Histone

Cluster 02 & 08	10403943	Hist1h2bm	2.39	Histone
Cluster 02 & 08	10494405	Hist2h3b/Hist1h3e/Hist1h3b/Hist1h3d/Hist1h3c/Hist1h3f/Hist2h3c2/ Hist2h3c1	2.50	Histone
Cluster 02 & 08	10494402	Hist2h3c1/Hist2h3b/Hist1h3e/Hist1h3b/Hist1h3d/Hist1h3c/Hist1h3f/ Hist2h3c2	2.53	Histone
Cluster 02 & 08	10408081	Hist1h1b	3.12	Histone
Cluster 02 & 08	10406663	Arsb	5.87	Hydrolase
Cluster 02 & 08	10406672	Arsb	6.27	Hydrolase
Cluster 02 & 08	10554863	Sytl2	2.45	Membrane trafficking regulatory protein
Cluster 02 & 08	10400383	2700097O09Rik	3.15	Methyltransferase
Cluster 02 & 08	10603431	Suv39h1	2.28	Methyltransferase, DNA binding protein
Cluster 02 & 08	10521136	Whsc1	2.86	Methyltransferase, DNA binding protein
Cluster 02 & 08	10462796	Kif11	5.81	Microtubule binding motor protein
Cluster 02 & 08	10601011	Kif4/Pdzd11	6.15	Microtubule binding motor protein
Cluster 02 & 08	10603567	Dynlt3	3.38	Microtubule family cytoskeletal protein
Cluster 02 & 08	10424676	Ly6e (Sca-2)	2.08	Misc.
Cluster 02 & 08	10543319	Fam3c	2.12	Misc.
Cluster 02 & 08	10405427	Prelid1/Rab24	2.14	Misc.
Cluster 02 & 08	10377605	1810027O10Rik	2.16	Misc.
Cluster 02 & 08	10582190	Gins2/Gse1	2.29	Misc.
Cluster 02 & 08	10462136	Cycs	2.33	Misc.
Cluster 02 & 08	10528170	Cycs	2.42	Misc.
Cluster 02 & 08	10601473	Apool	2.47	Misc.
Cluster 02 & 08	10532944	Mlec	2.52	Misc.
Cluster 02 & 08	10544660	Osbpl3	2.60	Misc.
Cluster 02 & 08	10532954	Mlec	2.81	Misc.
Cluster 02 & 08	10568217	Dctpp1	2.84	Misc.
Cluster 02 & 08	10355050	Raph1	2.92	Misc.
Cluster 02 & 08	10573451	Syce2	2.94	Misc.
Cluster 02 & 08	10495945	4930422G04Rik	3.04	Misc.
Cluster 02 & 08	10508986	Stmn1	3.11	Misc.
Cluster 02 & 08	10378053	Fam64a	3.21	Misc.
Cluster 02 & 08	10426669	Troap	3.22	Misc.
Cluster 02 & 08	10513818	Stmn1	3.26	Misc.
Cluster 02 & 08	10590909	Endod1	3.36	Misc.
Cluster 02 & 08	10429564	Ly6a (TAP, Sca-1)	3.45	Misc.
Cluster 02 & 08	10409190	Cenpp	3.81	Misc.
Cluster 02 & 08	10508151	Clspn	3.94	Misc.
Cluster 02 & 08	10568714	Mki67 (Ki67)	4.18	Misc.
Cluster 02 & 08	10420426	F630043A04Rik	4.87	Misc.
Cluster 02 & 08	10410560	Trip13	5.04	Misc.
Cluster 02 & 08	10411359	Plp2/Prickle3	5.10	Misc.
Cluster 02 & 08	10525591	Kntc1	5.13	Misc.
Cluster 02 & 08	10473022	Plp2	5.39	Misc.
Cluster 02 & 08	10485674	2700007P21Rik	5.77	Misc.
Cluster 02 & 08	10499639	Cks1b/Gm6340	5.90	Misc.
Cluster 02 & 08	10516246	Cdca8	6.11	Misc.
Cluster 02 & 08	10475517	AA467197/Mir147	6.92	Misc.
Cluster 02 & 08	10389606	Prr11	7.39	Misc.
Cluster 02 & 08	10462866	Cep55	7.55	Misc.
Cluster 02 & 08	10534456	Hip1	2.58	Non-motor actin binding protein
Cluster 02 & 08	10427166	Esp11	2.87	Nucleic acid binding
Cluster 02 & 08	10547943	Ncapd2	2.89	Nucleic acid binding
Cluster 02 & 08	10373515	Suox	3.21	Oxidase
Cluster 02 & 08	10475610	Dut	2.81	Phosphatase
Cluster 02 & 08	10367076	Prim1	4.46	Primase
Cluster 02 & 08	10382998	Birc5	5.00	Protease inhibitor
Cluster 02 & 08	10394978	Rrm2	4.69	Reductase
Cluster 02 & 08	10455595	Eno1/Gm5506	2.71	RNA binding, phosphopyruvate hydratase activity
Cluster 02 & 08	10473240	Eno1/Gm5506	2.75	RNA binding, phosphopyruvate hydratase activity
Cluster 02 & 08	10584435	Vwa5a	2.51	Serine protease inhibitor
Cluster 02 & 08	10519983	Fgl2	6.67	Signaling molecule
Cluster 02 & 08	10433088	Cbx5	3.23	Transcription factor, chromatin/chromatin-binding protein
Cluster 02 & 08	10366277	E2f7	2.12	Transcription factor, nucleic acid binding
Cluster 02 & 08	10587792	Plscr1	4.82	Transfer/carrier protein
Cluster 02 & 08	10517336	Clic4	3.35	Transferase, signaling molecule, reductase, translation elongation factor, epimerase/racemase, cytoskeletal protein

Cluster 02 & 08	10354389	Slc39a10	2.81	Transporter
Cluster 02 & 08	10491091	Tnfsf10	2.96	Tumor necrosis factor receptor
Cluster 02 & 08	10446074	Uhrf1	3.87	Ubiquitin-protein ligase
Cluster 02 & 08	10355967	Ap1s3	2.39	Vesicle coat protein
Cluster 02 & 09	10428857	Mtss1	2.04	Actin family cytoskeletal protein
Cluster 02 & 09	10534303	Lat2	7.88	Amino acid transporter
Cluster 02 & 09	10552697	Napsa	3.59	Aspartic protease
Cluster 02 & 09	10592330	Nrgn	13.60	calmodulin binding
Cluster 02 & 09	10553501	Slc17a6	11.02	Cation transporter
Cluster 02 & 09	10573261	Asf1b	3.27	Chromatin/chromatin-binding protein
Cluster 02 & 09	10385325	Pttg1	2.14	Cysteine-type endopeptidase inhibitor activity
Cluster 02 & 09	10527801	Brca2	2.34	Damaged DNA-binding protein
Cluster 02 & 09	10352048	Exo1	2.79	Damaged DNA-binding protein, endodeoxyribonuclease, exodeoxyribonuclease, nuclease, hydrolase
Cluster 02 & 09	10463064	Gapdh	2.09	Dehydrogenase
Cluster 02 & 09	10368612	Gapdh	2.15	Dehydrogenase
Cluster 02 & 09	10474239	Gapdh	2.16	Dehydrogenase
Cluster 02 & 09	10425903	Gapdh	2.30	Dehydrogenase
Cluster 02 & 09	10553301	Ldha	2.67	Dehydrogenase
Cluster 02 & 09	10472162	Gpd2	6.49	Dehydrogenase
Cluster 02 & 09	10452815	Xdh	4.71	Dehydrogenase, oxidase
Cluster 02 & 09	10574427	Impdh2	2.54	Dehydrogenase, reductase
Cluster 02 & 09	10485294	Hsd17b12	3.70	Dehydrogenase, reductase
Cluster 02 & 09	10572906	Mcm5	3.01	DNA helicase, hydrolase
Cluster 02 & 09	10474902	Rad51	7.39	DNA strand-pairing protein, hydrolase
Cluster 02 & 09	10379363	Atad5	2.97	DNA-binding protein
Cluster 02 & 09	10435581	Polq	2.26	DNA-directed DNA polymerase activity
Cluster 02 & 09	10605674	Pola1	2.66	Exodeoxyribonuclease, nuclease
Cluster 02 & 09	10523717	Spp1	87.69	Extracellular matrix binding
Cluster 02 & 09	10423293	Myo10	10.78	G-protein coupled modulator, actin binding motor protein, cell junction protein
Cluster 02 & 09	10407985	Gpr141	2.63	G-protein coupled receptor
Cluster 02 & 09	10546853	Srgap3	9.23	G-protein modulator
Cluster 02 & 09	10546855	Srgap3	10.24	G-protein modulator
Cluster 02 & 09	10408225	Hist1h4c	2.32	Histone
Cluster 02 & 09	10547830	Tpi1	7.60	Isomerase
Cluster 02 & 09	10509441	Ece1	2.35	Metalloprotease
Cluster 02 & 09	10454709	Kif20a/Cdc23	3.45	Microtubule binding motor protein
Cluster 02 & 09	10444505	Rdbp (Nelfe)	2.07	Misc.
Cluster 02 & 09	10593490	Gm6981/Gapdh	2.31	Misc.
Cluster 02 & 09	10465912	Fen1	2.32	Misc.
Cluster 02 & 09	10451547	10451547	2.36	Misc.
Cluster 02 & 09	10388880	Tmem97	2.40	Misc.
Cluster 02 & 09	10482432	10482432	2.42	Misc.
Cluster 02 & 09	10554817	10554817	2.43	Misc.
Cluster 02 & 09	10414431	10414431	2.49	Misc.
Cluster 02 & 09	10547916	Ptms	2.50	Misc.
Cluster 02 & 09	10463632	Tmem180	2.59	Misc.
Cluster 02 & 09	10364102	Chchd10	2.59	Misc.
Cluster 02 & 09	10393823	P4hb	2.60	Misc.
Cluster 02 & 09	10578916	Sc4mol	2.60	Misc.
Cluster 02 & 09	10486255	Oip5/Nusap1	2.65	Misc.
Cluster 02 & 09	10528480	Rpl17	2.72	Misc.
Cluster 02 & 09	10548565	Magohb	2.82	Misc.
Cluster 02 & 09	10440393	Samsn1	3.10	Misc.
Cluster 02 & 09	10369885	Cisd1	3.26	Misc.
Cluster 02 & 09	10597461	Cntm7	3.27	Misc.
Cluster 02 & 09	10535065	Adap1	3.41	Misc.
Cluster 02 & 09	10407946	Stard3nl	3.51	Misc.
Cluster 02 & 09	10519324	Cdk6	3.83	Misc.
Cluster 02 & 09	10515257	Rad54l	3.83	Misc.
Cluster 02 & 09	10420877	Esco2	3.93	Misc.
Cluster 02 & 09	10490838	Fabp5	3.99	Misc.
Cluster 02 & 09	10355329	Bard1	4.03	Misc.
Cluster 02 & 09	10371591	4930547N16Rik/Pmch	4.07	Misc.
Cluster 02 & 09	10585699	Fabp5	4.21	Misc.
Cluster 02 & 09	10568785	Bnip3	4.39	Misc.

Cluster 02 & 09	10545958	Anxa4	4.55	Misc.
Cluster 02 & 09	10568873	Adam8	4.59	Misc.
Cluster 02 & 09	10592201	Chek1	5.21	Misc.
Cluster 02 & 09	10471844	Nek6	5.41	Misc.
Cluster 02 & 09	10407955	Epdr1	6.14	Misc.
Cluster 02 & 09	10586744	Anxa2	6.59	Misc.
Cluster 02 & 09	10429140	Ndrg1	7.43	Misc.
Cluster 02 & 09	10461587	Ms4a4a	8.83	Misc.
Cluster 02 & 09	10414269	Bnip3	10.01	Misc.
Cluster 02 & 09	10595298	Filip1	13.26	Misc.
Cluster 02 & 09	10439845	Gm5486	17.88	Misc.
Cluster 02 & 09	10582549	Mela	64.18	Misc.
Cluster 02 & 09	10582545	Mela/Kcnma1	169.29	Misc.
Cluster 02 & 09	10594426	Zwilch/Lctl	3.29	Misc.
Cluster 02 & 09	10452508	Twsg1	4.68	Misc.
Cluster 02 & 09	10601705	Cenpi	2.98	mRNA splicing factor
Cluster 02 & 09	10518561	Apitd1	3.01	Neuropeptide
Cluster 02 & 09	10539135	Capg	13.60	Non-motor actin binding protein, calcium-binding protein
Cluster 02 & 09	10454786	Ctnna1	6.07	Non-motor actin binding protein, cell adhesion molecule
Cluster 02 & 09	10587508	Ttk	6.18	Non-receptor serine/threonine protein kinase
Cluster 02 & 09	10515295	Mast2	2.06	Non-receptor serine/threonine protein kinase, transfer/carrier protein, calmodulin
Cluster 02 & 09	10393431	Tk1	3.68	Nucleotide kinase
Cluster 02 & 09	10463070	Entpd1	7.00	Nucleotide phosphatase, lyase, nucleic acid binding
Cluster 02 & 09	10408531	Gmds	2.45	Oxidoreductase, dehydratase, epimerase/racemase
Cluster 02 & 09	10424349	Sqle	2.41	Oxygenase
Cluster 02 & 09	10350516	Ptgs2	18.45	Oxygenase
Cluster 02 & 09	10510260	Nppb	2.69	Peptide hormone
Cluster 02 & 09	10592001	St14	7.32	Peptide hormone, receptor, serine protease, protease inhibitor, annexin, calmodulin
Cluster 02 & 09	10367945	Phactr2	4.22	Phosphatase modulator
Cluster 02 & 09	10374236	Upp1	5.33	Phosphorylase
Cluster 02 & 09	10416037	Pbk	5.87	Protein kinase
Cluster 02 & 09	10483381	Stk39	4.14	Protein kinase activity
Cluster 02 & 09	10501629	Cdc14a	3.75	Protein phosphatase
Cluster 02 & 09	10585932	Pkm	2.52	Pyruvate kinase activity
Cluster 02 & 09	10351644	Cd244 (2B4)/LOC677008	3.56	Receptor
Cluster 02 & 09	10375443	Havr2 (TIM-3, CD366)	19.74	Receptor
Cluster 02 & 09	10473281	Igav (CD51)	5.73	Receptor, contributes to opsonin binding, contributes to protein kinase C binding
Cluster 02 & 09	10583732	Ldlr	2.42	Receptor, extracellular matrix glycoprotein
Cluster 02 & 09	10555695	Rrm1	3.28	Reductase
Cluster 02 & 09	10586604	Rps271	2.93	Ribosomal protein
Cluster 02 & 09	10372877	Xpot	2.61	RNA binding protein
Cluster 02 & 09	10420308	Gzmb	2.30	Serine protease
Cluster 02 & 09	10420295	Gzmf	161.81	Serine protease
Cluster 02 & 09	10404439	Serpinb9b	21.68	Serine protease inhibitor
Cluster 02 & 09	10414360	Lgals3	4.46	Signaling molecule, cell adhesion molecule
Cluster 02 & 09	10472501	Lass6 (Cers6)	4.85	Sphingosine N-acyltransferase
Cluster 02 & 09	10371959	Elk3/Cdk17	2.48	Transcription factor, DNA-binding protein
Cluster 02 & 09	10569057	Rnh1	2.16	Transcription factor, nucleic acid binding
Cluster 02 & 09	10582981	Tfdp1	2.96	Transcription factor, nucleic acid binding
Cluster 02 & 09	10521913	Rbpj	6.04	transcription factor, nucleic acid binding
Cluster 02 & 09	10576034	Irf8	13.65	Transcription factor, nucleic acid binding
Cluster 02 & 09	10438626	Etv5	5.75	Transcription factor, signaling molecule, nucleic acid binding
Cluster 02 & 09	10391461	Brcal	3.15	Transcription regulator, ubiquitin-protein ligase
Cluster 02 & 09	10383502	Slc16a3	4.61	Transporter
Cluster 02 & 09	10510580	Tnfrsf9 (4-1BB)	25.87	Tumor necrosis factor receptor
Cluster 02 & 09	10345752	Il1r2 (CD121b)	16.75	Type I cytokine receptor
Cluster 02 & 10	10556426	Parva	6.27	Actin and actin related protein
Cluster 02 & 10	10416800	Lmo7	3.60	Actin family cytoskeletal protein
Cluster 02 & 10	10489204	Tgm2	3.43	Acyltransferase
Cluster 02 & 10	10456522	Tcf4	3.19	Basic helix-loop-helix transcription factor, nucleic acid binding
Cluster 02 & 10	10498018	Pcdh18	3.43	Cadherin
Cluster 02 & 10	10533050	Hspb8	2.77	Chaperone
Cluster 02 & 10	10348632	Twist2	2.49	Chromatin binding, transcription factor activity, RNA polymerase II transcription factor binding, sequence-specific DNA binding
Cluster 02 & 10	10595371	Hmgn3	2.51	Chromatin/chromatin-binding protein
Cluster 02 & 10	10516735	Tinagl1	2.66	Cysteine protease

Cluster 02 & 10	10395320	Twist1	4.40	E-box binding, protein heterodimerization activity, transcription factor activity, sequence-specific DNA binding
Cluster 02 & 10	10531794	Wdfy3	3.66	Enzyme modulator
Cluster 02 & 10	10571142	Gpr124	2.98	G-protein coupled receptor, antibacterial response protein
Cluster 02 & 10	10588037	Rbp1	3.19	G-protein modulator
Cluster 02 & 10	10363173	Gja1	7.28	Gap junction
Cluster 02 & 10	10475643	Fgf7	2.94	Growth factor
Cluster 02 & 10	10476395	Bmp2	4.05	Growth factor
Cluster 02 & 10	10427402	Ghr	5.03	Growth hormone receptor
Cluster 02 & 10	10358733	Rgl1	7.61	guanyl-nucleotide exchange factor
Cluster 02 & 10	10465820	Gng3	4.69	Heterotrimeric G-protein
Cluster 02 & 10	10458663	Dpysl3	2.54	Hydrolase
Cluster 02 & 10	10481592	Dnm1	3.33	Hydrolase, small GTPase, microtubule family cytoskeletal protein
Cluster 02 & 10	10594110	Neo1	3.02	Immunoglobulin receptor superfamily, protein phosphatase, immunoglobulin superfamily cell adhesion molecule
Cluster 02 & 10	10501608	Vcam1 (CD106)	5.02	Immunoglobulin receptor superfamily, protein phosphatase, immunoglobulin superfamily cell adhesion molecule
Cluster 02 & 10	10523727	Pkd2	3.35	Ion channel, membrane-bound signaling molecule, G-protein modulator
Cluster 02 & 10	10458906	Ppic	3.81	Isomerase
Cluster 02 & 10	10538547	Fkbp9	2.65	isomerase, chaperone, calcium-binding protein
Cluster 02 & 10	10560190	Ehd2	4.87	Membrane traffic protein, G-protein modulator, calcium-binding protein
Cluster 02 & 10	10423548	Sdc2	4.58	Membrane-bound signaling molecule, extracellular matrix glycoprotein, defense/immunity protein, cytoskeletal protein, cell adhesion molecule
Cluster 02 & 10	10574027	Mt1	6.33	Metal ion binding
Cluster 02 & 10	10415052	Mmp14	3.21	Metalloendopeptidase
Cluster 02 & 10	10476648	Dstn	2.29	Misc.
Cluster 02 & 10	10500204	Ecm1	2.35	Misc.
Cluster 02 & 10	10421697	9030625A04Rik	2.44	Misc.
Cluster 02 & 10	10467191	Ankrd1	2.52	Misc.
Cluster 02 & 10	10356968	Pam	2.54	Misc.
Cluster 02 & 10	10403727	Gli3	2.60	Misc.
Cluster 02 & 10	10485948	Grem1	2.60	Misc.
Cluster 02 & 10	10485607	Qser1	2.84	Misc.
Cluster 02 & 10	10433264	Glis2	2.87	Misc.
Cluster 02 & 10	10567995	Nupr1	3.00	Misc.
Cluster 02 & 10	10381122	Fkbp10/Nt5c31	3.03	Misc.
Cluster 02 & 10	10427744	Rai14	3.42	Misc.
Cluster 02 & 10	10527965	Cldn12	3.45	Misc.
Cluster 02 & 10	10527940	Cdk14	4.07	Misc.
Cluster 02 & 10	10532741	Tmem119	4.35	Misc.
Cluster 02 & 10	10431935	Amigo2/Fam113b	4.73	Misc.
Cluster 02 & 10	10427125	Igfbp6	5.55	Misc.
Cluster 02 & 10	10394534	Osr1	6.33	Misc.
Cluster 02 & 10	10447951	Thbs2	6.86	Misc.
Cluster 02 & 10	10417759	Ube2e2/LOC100861885	2.88	Misc.
Cluster 02 & 10	10438603	Igf2bp2	2.42	mRNA splicing factor, ribonucleoprotein, enzyme modulator
Cluster 02 & 10	10472097	Fmn12	2.53	Non-motor actin binding protein
Cluster 02 & 10	10495659	Cnn3	2.65	Non-motor actin binding protein
Cluster 02 & 10	10345241	Dst	2.84	Non-motor actin binding protein
Cluster 02 & 10	10527158	Fsen1	3.50	Non-motor actin binding protein
Cluster 02 & 10	10537184	Cald1	5.72	Non-motor actin binding protein
Cluster 02 & 10	10352194	Cdc42bpa	2.31	Non-receptor serine/threonine protein kinase
Cluster 02 & 10	10528015	Steap1	3.66	NOT cupric reductase activity, NOT ferric-chelate reductase (NADPH) activity
Cluster 02 & 10	10564527	Nr2f2	6.27	Nuclear hormone receptor, receptor, nucleic acid binding
Cluster 02 & 10	10477061	Srxn1	2.39	Oxidoreductase activity, acting on a sulfur group of donors
Cluster 02 & 10	10356084	Irs1	2.69	phosphatidylinositol 3-kinase binding, protein kinase binding
Cluster 02 & 10	10424370	Trib1	2.29	Protein kinase
Cluster 02 & 10	10536505	Met	2.89	Protein kinase activity, hepatocyte growth factor-activated receptor activity
Cluster 02 & 10	10427095	Tenc1	2.53	Protein phosphatase
Cluster 02 & 10	10538150	Tmem176a	5.50	Receptor
Cluster 02 & 10	10439651	Cd200	6.34	Receptor
Cluster 02 & 10	10373223	Lrp1 (CD91)	3.21	Receptor, extracellular matrix glycoprotein
Cluster 02 & 10	10417212	Itgb11	2.76	Receptor, extracellular matrix glycoprotein, cell adhesion molecule
Cluster 02 & 10	10490384	Lama5	2.24	Receptor, extracellular matrix linker protein

Cluster 02 & 10	10395163	Lamb1	3.91	Receptor, extracellular matrix linker protein
Cluster 02 & 10	10375175	Slit3	3.30	Receptor, extracellular matrix protein
Cluster 02 & 10	10463836	Gsto1	2.60	Serine protease
Cluster 02 & 10	10355984	Serpine2	4.18	Serine protease inhibitor
Cluster 02 & 10	10388430	Serpinf1	5.04	Serine protease inhibitor
Cluster 02 & 10	10446928	Ltbp1	3.95	Signaling molecule
Cluster 02 & 10	10422728	Dab2	8.72	Signaling molecule
Cluster 02 & 10	10484227	Sestd1	3.03	Signaling molecule, guanyl-nucleotide exchange factor
Cluster 02 & 10	10564220	Gkap1	2.24	Structural protein
Cluster 02 & 10	10416175	Nefl	2.40	Structural protein, intermediate filament
Cluster 02 & 10	10421100	Nefm	3.66	Structural protein, intermediate filament
Cluster 02 & 10	10416522	Tsc22d1	3.59	Transcription factor
Cluster 02 & 10	10432540	Lima1	2.59	Transcription factor, nuclease, actin family cytoskeletal protein
Cluster 02 & 10	10576049	Foxf1	4.49	Transcription factor, nucleic acid binding
Cluster 02 & 10	10372796	Hmga2	5.49	Transcriptional activator activity, DNA-binding protein
Cluster 02 & 10	10548905	Eps8	5.04	Transmembrane receptor regulatory/adaptor protein
Cluster 02 & 10	10536494	Cav2	5.27	Transmembrane receptor regulatory/adaptor protein, structural protein, membrane traffic protein, G-protein modulator
Cluster 02 & 10	10387791	Slc16a13	2.95	Transporter
Cluster 02 & 10	10346843	Nrp2	2.71	Transporter, apolipoprotein, membrane-bound signaling molecule, receptor, metalloprotease, serine protease, oxidase, metalloprotease, serine protease, extracellular matrix protein, enzyme modulator, cell adhesion molecule
Cluster 02 & 10	10490989	Cp	3.01	Transporter, apolipoprotein, membrane-bound signaling molecule, receptor, metalloprotease, serine protease, oxidase, metalloprotease, serine protease, extracellular matrix protein, enzyme modulator, cell adhesion molecule
Cluster 02 & 10	10536220	Col1a2	3.38	Transporter, surfactant, receptor, extracellular matrix structural protein, antibacterial response protein
Cluster 02 & 10	10440091	Col8a1	3.24	Transporter, surfactant, receptor, extracellular matrix structural protein, antibacterial response protein, cell adhesion molecule
Cluster 02 & 11	10351206	Selp	5.66	Adpolipoprotein, receptor, metalloprotease, serine protease, complement component, cell adhesion molecule
Cluster 02 & 11	10536818	Calu	2.91	Calmodulin
Cluster 02 & 11	10605766	Maged1	8.12	Cell adhesion molecule
Cluster 02 & 11	10360315	Fcrl6	10.72	Cell adhesion molecule
Cluster 02 & 11	10379511	Ccl2	21.26	Chemokine
Cluster 02 & 11	10528008	Steap2	8.35	Cupric reductase activity, ferric-chelate reductase (NADPH) activity
Cluster 02 & 11	10521667	Bst1	2.39	Cyclase, glycosidase
Cluster 02 & 11	10410124	Ctsl	16.42	Cysteine protease
Cluster 02 & 11	10364375	Cstb	2.26	Cysteine protease inhibitor
Cluster 02 & 11	10545672	Mthfd2	2.26	Dehydrogenase, ligase, hydrolase
Cluster 02 & 11	10460585	Foxl1/Ccde85b	3.74	DNA-binding protein
Cluster 02 & 11	10553598	Cyfip1	3.07	G-protein modulator
Cluster 02 & 11	10350725	Rgs8	8.05	G-protein modulator
Cluster 02 & 11	10458340	Hbegf	6.27	Growth factor
Cluster 02 & 11	10502655	Cyr61	8.77	Growth factor
Cluster 02 & 11	10523175	Ereg	11.01	Growth factor
Cluster 02 & 11	10417095	Farp1	4.58	Guanyl-nucleotide exchange factor
Cluster 02 & 11	10359624	Prrx1	11.05	Homeobox transcription factor, DNA binding protein
Cluster 02 & 11	10565315	Fah	3.01	Isomerase, hydrolase
Cluster 02 & 11	10569646	Ccnd1	9.76	Kinase activator
Cluster 02 & 11	10473356	Ube2l6	2.85	Ligase
Cluster 02 & 11	10377938	Eno3	6.08	Lyase
Cluster 02 & 11	10467258	Myof	7.47	Membrane traffic protein
Cluster 02 & 11	10423520	Sema5a	5.16	Membrane-bound signaling molecule
Cluster 02 & 11	10519717	Sema3a	10.77	Membrane-bound signaling molecule
Cluster 02 & 11	10498576	Lxn	7.57	Metalloendopeptidase inhibitor
Cluster 02 & 11	10598976	Timp1	20.58	Metalloprotease inhibitor
Cluster 02 & 11	10585214	Cryab/Hspb2	2.10	Misc.
Cluster 02 & 11	10525887	Bri3bp	2.13	Misc.
Cluster 02 & 11	10386947	10386947	2.33	Misc.
Cluster 02 & 11	10539263	Loxl3/Htra2	2.42	Misc.
Cluster 02 & 11	10389238	Dusp14	2.47	Misc.
Cluster 02 & 11	10359929	Ddr2	2.51	Misc.
Cluster 02 & 11	10361887	Perp	2.58	Misc.
Cluster 02 & 11	10542791	Ppfibp1	2.89	Misc.
Cluster 02 & 11	10428103	Stk3	3.06	Misc.
Cluster 02 & 11	10368508	Cenpw	3.23	Misc.

Cluster 02 & 11	10346747	Cyp20a1	3.37	Misc.
Cluster 02 & 11	10411519	Mtap1b	3.42	Misc.
Cluster 02 & 11	10501222	Gstm2	3.73	Misc.
Cluster 02 & 11	10417124	B930095G15Rik	4.47	Misc.
Cluster 02 & 11	10547740	C1s/Gm5077	4.79	Misc.
Cluster 02 & 11	10439009	Apod	4.97	Misc.
Cluster 02 & 11	10561104	Axl	5.48	Misc.
Cluster 02 & 11	10360398	Ifi202b	5.57	Misc.
Cluster 02 & 11	10498273	Tm4sf1	6.00	Misc.
Cluster 02 & 11	10497817	Anxa5	6.44	Misc.
Cluster 02 & 11	10346164	Sdpr	6.95	Misc.
Cluster 02 & 11	10577641	1810011O10Rik	8.86	Misc.
Cluster 02 & 11	10388254	Aspa	8.88	Misc.
Cluster 02 & 11	10405063	Ogn	9.17	Misc.
Cluster 02 & 11	10405047	Aspn	9.56	Misc.
Cluster 02 & 11	10523451	Anxa3	11.17	Misc.
Cluster 02 & 11	10608724	10608724	16.00	Misc.
Cluster 02 & 11	10360070	Fcer1g	18.33	Misc.
Cluster 02 & 11	10408689	Nrn1	20.96	Misc.
Cluster 02 & 11	10535559	Baiap211 (IRTKS)	24.42	Misc.
Cluster 02 & 11	10502224	Sgms2	3.37	Misc.
Cluster 02 & 11	10348354	Ugt1a9/Ugt1a1/Ugt1a5/Ugt1a10/Ugt1a2/ Ugt1a6a/Ugt1a7c	5.52	Misc.
Cluster 02 & 11	10453825	Snrpd1	2.02	mRNA splicing factor, ribonucleoprotein
Cluster 02 & 11	10523511	Prkg2	8.92	
Cluster 02 & 11	10390117	Itga3 (CD49c)	2.68	Non-receptor serine/threonine protein kinase
Cluster 02 & 11	10521759	Slit2	19.17	Receptor
Cluster 02 & 11	10537146	Akr1b8	5.58	Receptor, extracellular matrix protein
Cluster 02 & 11	10433480	Rpl39l	16.63	Reductase
Cluster 02 & 11	10420274	Gzmd	95.97	Ribosomal protein
Cluster 02 & 11	10565794	Serpinh1	2.97	serine protease
Cluster 02 & 11	10484463	Serping1	5.36	Serine protease inhibitor
Cluster 02 & 11	10403834	Sfrp4	2.27	Serine protease inhibitor
Cluster 02 & 11	10605797	Arhgef9	4.41	Signaling molecule, G-protein coupled receptor
Cluster 02 & 11	10495054	Rhoc	3.11	Signaling molecule, G-protein coupled receptor
Cluster 02 & 11	10548879	Mgp	9.25	Signaling molecule, G-protein coupled receptor
Cluster 02 & 11	10466745	Tjp2	2.43	small GTPase
Cluster 02 & 11	10442327	Cldn6	3.20	Structural protein, signaling molecule, extracellular matrix
Cluster 02 & 11	10400006	Ahr	3.29	structural protein, annexin, calmodulin
Cluster 02 & 11	10391332	Ptfr	3.60	Tight junction
Cluster 02 & 11	10353010	Mybl1	3.14	Tight junction
Cluster 02 & 11	10514054	Nfib	3.79	Transcription factor
Cluster 02 & 11	10458555	Spry4	3.86	Transcription factor, DNA binding protein
Cluster 02 & 11	10562905	Atf5/Nup62/Nup62-il4i1/Il4i1	2.10	Transcription factor, nucleic acid binding
Cluster 02 & 11	10536499	Cav1	20.84	Transcription factor, signaling molecule
Cluster 02 & 11	10487021	Slc30a4	7.81	Transcription regulator
Cluster 02 & 11	10534862	Pcolce	22.29	Transmembrane receptor regulatory/adaptor protein, structural protein, membrane traffic protein, G-protein modulator
Cluster 02 & 11	10456400	Tubb6	5.81	Transporter
Cluster 02 & 11	10585395	Siva1	2.78	Transporter, apolipoprotein, membrane-bound signaling molecule, receptor, metalloprotease, serine protease, oxidase, metalloprotease, serine protease, extracellular matrix protein, enzyme modulator, cell adhesion molecule
Cluster 02 & 11	10398874	Siva1	2.82	Tubulin
Cluster 02 & 12	10519555	Abcb1b	2.51	Virus receptor activity
Cluster 02 & 12	10544002	Creb3l2	3.35	Virus receptor activity
Cluster 02 & 12	10385912	Csf2	5.30	ATP-binding cassette (ABC) transporter
Cluster 02 & 12	10501164	Csf1	9.94	CREB transcription factor, nucleic acid binding
Cluster 02 & 12	10590242	Ccr8	4.14	Cytokine
Cluster 02 & 12	10350733	Rgs16	14.23	Cytokine
Cluster 02 & 12	10424543	Wisp1	3.06	G-protein coupled receptor, immunoglobulin receptor superfamily, protein phosphatase, immunoglobulin superfamily cell adhesion molecule
Cluster 02 & 12	10404053	Hist1h2bc/Hist1h2bg/Hist1h2be	7.38	G-protein modulator
Cluster 02 & 12	10355312	Ikzf2	5.79	Growth factor
Cluster 02 & 12	10548430	Gm156	39.76	Histone
				KRAB box transcription factor
				Membrane-bound signaling molecule, receptor, defense/immunity protein

Cluster 02 & 12	10459905	Setbp1	4.45	Methyltransferase, DNA binding protein
Cluster 02 & 12	10542205	Klre1	7.99	Microtubule binding motor protein
Cluster 02 & 12	10481491	Ier5l	2.25	Misc.
Cluster 02 & 12	10462398	Pdcd1lg2 (PD-L2)	2.28	Misc.
Cluster 02 & 12	10539617	Alms1	2.31	Misc.
Cluster 02 & 12	10366043	Dusp6	2.42	Misc.
Cluster 02 & 12	10544250	E330009J07Rik	2.44	Misc.
Cluster 02 & 12	10444890	Ier3	2.55	Misc.
Cluster 02 & 12	10361995	Fam54a	2.79	Misc.
Cluster 02 & 12	10369290	Ddit4	3.24	Misc.
Cluster 02 & 12	10536794	Hilpda	3.25	Misc.
Cluster 02 & 12	10349081	Phlpp1	3.29	Misc.
Cluster 02 & 12	10513190	D630039A03Rik	3.46	Misc.
Cluster 02 & 12	10548735	Dusp16	3.83	Misc.
Cluster 02 & 12	10605792	Spin4	4.39	Misc.
Cluster 02 & 12	10356866	Pdcd1 (PD1)	13.60	Misc.
Cluster 02 & 12	10442224	Zfp948	2.07	Misc.
Cluster 02 & 12	10544732	Skap2	2.34	Misc.
Cluster 02 & 12	10587829	Plod2	8.37	Oxygenase
Cluster 02 & 12	10571321	Ppp1r3b	3.64	Phosphatase modulator
Cluster 02 & 12	10463168	Pgam1	2.46	Phosphoglycerate mutase activity
Cluster 02 & 12	10561302	Pgam1	2.46	Phosphoglycerate mutase activity
Cluster 02 & 12	10497321	Pgam1	2.65	Phosphoglycerate mutase activity
Cluster 02 & 12	10513154	Ptpn3	3.08	Protein phosphatase
Cluster 02 & 12	10407126	Plk2	5.04	Protein serine/threonine kinase activity
Cluster 02 & 12	10435704	Cd80	4.95	Receptor
Cluster 02 & 12	10404422	Serpinh6b	2.73	Serine protease inhibitor
Cluster 02 & 12	10404429	Serpinh9	3.69	Serine protease inhibitor
Cluster 02 & 12	10503334	Gem	4.87	Small GTPase
Cluster 02 & 12	10536472	Mdfic	2.15	Transcription factor
Cluster 02 & 12	10437687	Litaf	7.45	Transcription factor
Cluster 02 & 12	10391301	Stat3	2.24	Transcription factor, nucleic acid binding
Cluster 02 & 12	10422227	Spry2	4.87	Transcription factor, signaling molecule
Cluster 02 & 12	10356082	Plscr1	4.12	Transfer/carrier protein
Cluster 02 & 12	10511282	Tnfrsf4	10.45	Tumor necrosis factor receptor
Cluster 02 & 12	10545135	Il12rb2	4.48	Type I cytokine receptor, defense/immunity protein
Cluster 02 & 12	10462454	Uhrf2	2.50	Ubiquitin-protein ligase
Cluster 02 & 13	10447190	Plekhh2	2.45	Actin binding
Cluster 02 & 13	10594661	Tpm1	2.36	Actin binding motor protein
Cluster 02 & 13	10408870	Tbc1d7	2.59	Activation of GTPase activity, negative regulation of TOR signaling
Cluster 02 & 13	10379518	Ccl7	5.67	Chemokine
Cluster 02 & 13	10415844	Ctsb/Fdft1	2.40	Cysteine protease
Cluster 02 & 13	10488415	Cst3	2.70	Cysteine protease inhibitor
Cluster 02 & 13	10437639	Emp2	6.66	Cytoskeletal protein
Cluster 02 & 13	10497001	Cryz	3.11	Dehydrogenase, reductase
Cluster 02 & 13	10476362	Mcm8	2.16	DNA helicase, hydrolase
Cluster 02 & 13	10534974	Mcm7	2.71	DNA helicase, hydrolase
Cluster 02 & 13	10417273	Esd	2.56	Esterase
Cluster 02 & 13	10493259	Ssr2	2.41	G-protein coupled receptor
Cluster 02 & 13	10539861	Rpn1	2.46	Glycosyltransferase
Cluster 02 & 13	10555041	Alg8	2.63	Glycosyltransferase
Cluster 02 & 13	10466521	Gent1	8.92	Glycosyltransferase
Cluster 02 & 13	10386058	Sparc	8.39	Growth factor, extracellular matrix glycoprotein, cell adhesion molecule
Cluster 02 & 13	10481518	Ptges	6.98	Isomerase
Cluster 02 & 13	10432243	Fkbp11	2.65	Isomerase, chaperone, calcium-binding protein
Cluster 02 & 13	10367436	Cd63	79.88	Membrane-bound signaling molecule, receptor
Cluster 02 & 13	10574023	Mt2	7.84	Metal ion binding
Cluster 02 & 13	10467979	Scd1	21.69	Metal ion binding, palmitoyl-CoA 9-desaturase activity, stearoyl-CoA 9-desaturase activity
Cluster 02 & 13	10393559	Timp2	5.22	Metalloprotease inhibitor
Cluster 02 & 13	10372410	Glipr1/Krr1	2.00	Misc.
Cluster 02 & 13	10554281	Fanci/Polg	2.19	Misc.
Cluster 02 & 13	10419223	Fermt2	2.21	Misc.
Cluster 02 & 13	10460603	Efemp2	2.25	Misc.
Cluster 02 & 13	10538617	Lancel2	2.26	Misc.
Cluster 02 & 13	10528143	Ppp1r14b	2.29	Misc.
Cluster 02 & 13	10497548	Fndc3b	2.64	Misc.

Cluster 02 & 13	10465895	Fads2	2.79	Misc.
Cluster 02 & 13	10585338	Kdelc2	2.92	Misc.
Cluster 02 & 13	10472916	Cdca7	2.96	Misc.
Cluster 02 & 13	10398240	Eml1	3.03	Misc.
Cluster 02 & 13	10480381	Arhgap21	3.20	Misc.
Cluster 02 & 13	10421029	Cdca2	3.62	Misc.
Cluster 02 & 13	10485622	Qser1	4.00	Misc.
Cluster 02 & 13	10603346	Plp2/Prickle3	5.01	Misc.
Cluster 02 & 13	10436106	C330027C09Rik	5.16	Misc.
Cluster 02 & 13	10569707	Myadm	5.50	Misc.
Cluster 02 & 13	10450374	D17H6S56E-5 (G7e)	5.83	Misc.
Cluster 02 & 13	10466606	Anxa1	6.74	Misc.
Cluster 02 & 13	10553299	Ifitm2	7.15	Misc.
Cluster 02 & 13	10591781	Anln	7.76	Misc.
Cluster 02 & 13	10383756	Ifitm2	7.94	Misc.
Cluster 02 & 13	10569014	Ifitm2	10.27	Misc.
Cluster 02 & 13	10558769	Ifitm1	12.93	Misc.
Cluster 02 & 13	10569017	Ifitm3	14.75	Misc.
Cluster 02 & 13	10384373	Fignl1	4.64	Non-motor microtubule binding protein
Cluster 02 & 13	10504672	Tdrd7	2.14	Nuclease
Cluster 02 & 13	10418171	Zcchc24	3.45	Nuclease
Cluster 02 & 13	10476989	Gins1	4.82	Nucleic acid binding
Cluster 02 & 13	10563883	Depdc1a	7.02	Nucleic acid binding
Cluster 02 & 13	10497122	Depdc1a	7.39	Nucleic acid binding
Cluster 02 & 13	10524621	Oas2	2.84	Nucleotidyltransferase, nucleic acid binding, defense/immunity protein
Cluster 02 & 13	10471721	Ptgs1	8.34	Oxygenase
Cluster 02 & 13	10484318	Nckap1	3.54	Protein complex binding, contributes to Rac GTPase binding
Cluster 02 & 13	10458382	Cd14	5.34	Receptor
Cluster 02 & 13	10474671	Spred1	6.78	Receptor
Cluster 02 & 13	10352905	Cd34	13.31	Receptor
Cluster 02 & 13	10510546	Eno1/Gm5506	2.65	RNA binding, phosphopyruvate hydratase activity
Cluster 02 & 13	10355403	Fn1	26.38	Signaling molecule
Cluster 02 & 13	10551638	Lgals7	5.72	Signaling molecule, cell adhesion molecule
Cluster 02 & 13	10391339	Psmc3ip	2.53	Signaling molecule, DNA-binding protein, enzyme modulator
Cluster 02 & 13	10525983	Ran	2.30	Small GTPase
Cluster 02 & 13	10523281	Sept11	2.74	Small GTPase, cytoskeletal protein
Cluster 02 & 13	10469322	Vim/LOC100862060	2.20	Structural molecule activity
Cluster 02 & 13	10564343	Tjp1	5.52	Tight junction
Cluster 02 & 13	10385716	0610009B22Rik	2.56	Transcription regulator
Cluster 02 & 13	10377790	Slc16a11	2.45	Transporter
Cluster 02 & 14	10572932	Naa20	2.07	Acetyltransferase
Cluster 02 & 14	10476775	Naa20	2.13	Acetyltransferase
Cluster 02 & 14	10350136	Csrp1	2.25	Actin family cytoskeletal protein
Cluster 02 & 14	10447317	Epas1	3.93	Basic helix-loop-helix transcription factor, nucleic acid binding
Cluster 02 & 14	10592266	Slc37a2	3.78	Cation transporter
Cluster 02 & 14	10531407	Cxcl9	4.24	Chemokine
Cluster 02 & 14	10571696	Casp3	3.47	Cysteine protease, protease inhibitor
Cluster 02 & 14	10393047	Galk1/Itgb4	2.66	Galactokinase activity
Cluster 02 & 14	10531737	Hpse	9.61	Glycosidase
Cluster 02 & 14	10403743	Inhba	2.66	Growth factor
Cluster 02 & 14	10344713	Ahey	2.14	Hydrolase
Cluster 02 & 14	10488816	Ahey	2.18	Hydrolase
Cluster 02 & 14	10439762	Ahey	2.26	Hydrolase
Cluster 02 & 14	10521832	Pi4k2b	2.42	Kinase
Cluster 02 & 14	10353899	Sema4c	2.19	Membrane-bound signaling molecule
Cluster 02 & 14	10369431	Adams14	2.73	Metalloprotease, extracellular matrix glycoprotein, serine protease inhibitor
Cluster 02 & 14	10608652	10608652	2.08	Misc.
Cluster 02 & 14	10458794	Ccdc112	2.12	Misc.
Cluster 02 & 14	10425966	Atxn10	2.17	Misc.
Cluster 02 & 14	10593913	1700017B05Rik	2.26	Misc.
Cluster 02 & 14	10461439	Fads1	2.29	Misc.
Cluster 02 & 14	10585610	Ptpn9/Gm10658	2.34	Misc.
Cluster 02 & 14	10406733	Zbed3	2.35	Misc.
Cluster 02 & 14	10488589	Fam110a	2.53	Misc.
Cluster 02 & 14	10450519	Tcf19	2.67	Misc.
Cluster 02 & 14	10479379	Slco4a1	2.68	Misc.
Cluster 02 & 14	10467907	Erlin1	2.74	Misc.

Cluster 02 & 14	10495935	4930422G04Rik (Zgrf1)	2.76	Misc.
Cluster 02 & 14	10527920	Cyp51	2.78	Misc.
Cluster 02 & 14	10506822	Orc1	2.78	Misc.
Cluster 02 & 14	10441864	Mllt4	2.92	Misc.
Cluster 02 & 14	10540738	Fancd2	3.00	Misc.
Cluster 02 & 14	10361110	Dtl	3.05	Misc.
Cluster 02 & 14	10459071	2010002N04Rik (Smim3)	3.14	Misc.
Cluster 02 & 14	10550906	Plaur (CD87)	3.58	Misc.
Cluster 02 & 14	10355567	Tmbim1	3.76	Misc.
Cluster 02 & 14	10426689	Spats2	3.94	Misc.
Cluster 02 & 14	10532669	2900026A02Rik	4.12	Misc.
Cluster 02 & 14	10502816	Gipc2/D630002J18Rik	4.39	Misc.
Cluster 02 & 14	10406581	Dhfr/Msh3	4.57	Misc.
Cluster 02 & 14	10460738	Cdca5	4.99	Misc.
Cluster 02 & 14	10530615	Ociad2	5.67	Misc.
Cluster 02 & 14	10571312	Dusp4	6.55	Misc.
Cluster 02 & 14	10411459	Tmem171	7.33	Misc.
Cluster 02 & 14	10357579	Mapkapk2	2.42	Non-receptor serine/threonine protein kinase, non-motor microtubule binding protein
Cluster 02 & 14	10535979	Rfc3	3.52	Nucleotidyltransferase, DNA-directed DNA polymerase
Cluster 02 & 14	10419198	Ero1l	3.02	Oxidoreductase
Cluster 02 & 14	10463355	Scd2	6.47	Palmitoyl-CoA 9-desaturase activity, stearoyl-CoA 9-desaturase activity
Cluster 02 & 14	10452047	Ptprs	2.98	Protein phosphatase
Cluster 02 & 14	10491805	Plk4	2.66	Protein serine/threonine kinase activity
Cluster 02 & 14	10374464	Spred2	2.83	Receptor
Cluster 02 & 14	10439527	Tigit	3.68	Receptor, defense/immunity protein
Cluster 02 & 14	10403584	Nid1	2.50	Receptor, extracellular matrix glycoprotein
Cluster 02 & 14	10358816	Lamc1	2.95	Receptor, extracellular matrix linker protein
Cluster 02 & 14	10420302	Gzmc	54.76	serine protease
Cluster 02 & 14	10469151	Itih5	9.86	Serine protease inhibitor
Cluster 02 & 14	10379262	Nfl	2.45	Signaling molecule, G-protein modulator
Cluster 02 & 14	10409660	Gkap1	2.74	Structural protein
Cluster 02 & 14	10455813	Lmb1	2.27	Structural protein, intermediate filament
Cluster 02 & 14	10549222	Bcat1	6.18	Transaminase
Cluster 02 & 14	10408321	Gmn	2.46	Transcription corepressor activity
Cluster 02 & 14	10576639	Nrp1	2.13	Transporter, apolipoprotein, membrane-bound signaling molecule, receptor, metalloprotease, serine protease, oxidase, metalloprotease, serine protease, extracellular matrix protein, enzyme modulator, cell adhesion molecule
Cluster 02 & 14	10556216	Ipo7	2.09	Transporter, small GTPase
Cluster 02 & 14	10519488	Tubb4b	2.09	Tubulin

Supplemental Table 3. The molecular profile of TIL consists of 1164 differentially expressed genes between all tumor-specific CD8⁺ T cells from the tumor (TIL_{TOT}) and spleen (SP_{TOT}) from Figure 2A. Differentially-expressed genes were narrowed as described in Figure 4 to determine the molecular profile of TASPRL TIL. The gene list is ordered by K-means cluster (Figure 5A), gene type, and fold-change. Genes without a definitive gene type were labeled “Misc.” for miscellaneous.