# **Supporting Information**

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#### **SI Text**

A simple version of the MiDReG program is available at the following web site: http://genepyramid.stanford.edu/microarray/MiDReG/.

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**Fig. S1.** Purification of B-cell precursors. Precursor populations on B-cell development pathway were purified by fluorescent-activated cell sorting from either the marrow (A–G) or the spleen (H–I) of naive mice or the spleen from immunized mice (J). Definition of cell surface markers for populations are as follows: (A) HSC,  $CD34^{-}Flk2^{-}cKit^{+}Sca^{-1}+Lin(Mac^{-1}, Gr^{-1}, B220, CD4, CD8, IL-7Ra, and Ter119]^{-}; MPPFL^{-}, CD34^{+}Flk2^{-}cKit^{+}Sca^{-1}+Lin^{-}; MPPFL^{+}, CD34^{+}Flk2^{+}cKit^{+}Sca^{-1}+Lin^{-}; (B) CLP, Ly6c^{-}NK1.1^{-}CD11c^{-}CD27^{+}CD19^{-}B220^{-}Flk2^{+}IL-7Ra^{+}BP^{-1}; (C) fraction A, Ly6c^{-}NK1.1^{-}CD11c^{-}CD27^{+}L^{-}7Ra^{+}BP^{-1}; (C) fraction B, Ly6c^{-}NK1.1^{-}CD11c^{-}CD27^{+}L^{-}7Ra^{+}BP^{-1}; (E) fraction C, IgD^{-}NK1.1^{-}B220^{+}CD43^{+}CD19^{+}IL-7Ra^{+}BP^{-1}; (F) fraction D, IgD^{-}NK1.1^{-}IgM^{+}B220^{+}CD43^{-}CD19^{+}IL^{-}7Ra^{+}BP^{-1}; (G) fraction E, IgD^{-}NK1.1^{-}IgM^{+}B220^{+}CD43^{-}CD19^{+}IL^{-}7Ra^{+}BP^{-1}; (F) fraction D, IgD^{-}NK1.1^{-}IgM^{+}CD23^{-}Mac^{-1}Gr^{-1}CD3^{-}CD4^{-}CD8^{-}Ter119^{-}; (I) B220^{+}AA4.1^{+}IgM^{+}CD23^{+}Mac^{-1}Gr^{-1}CD3^{-}CD4^{-}CD8^{-}Ter119^{-}; (I) geminal$ 

## Table S1. Predicted B-cell genes

AHHGAPA         204425 at         ArhgapA         1419285, at           BACH2         227173, st         Bach2         1441657, at           BLK         206255, at         Bita         1452775, at           BLK         206256, at         Bita         1450556, at           CCR6         206983, at         Ccr67         1423466, at           CO180         206206, at         Cd120         1421547, at           CO22         2117422, s, at         Cd120         1421547, at           CO72         215925, s, at         Cd77         1423466, at           CO72         215925, s, at         Cd72         1459744, at           CO72         215925, s, at         Cd72         142676, at           CO74         205049, s, at, 1555779, a, at         Cd79a         1418830, at           CD780         125519, at         Cd860         1420717, at, 1432826, at           CLEC2D         220132, s, at, 23500, s, at, 225522, at         Cd864         1420477, at           DFMDIC         220132, s, at, 23500, s, at, 25552, at         Checkd         141977, at           DFMA         221602, s, at, 235400, at         ForerAa         1422889, at           CER7         206755, at, 205670, s, at         ForerAa	Human gene	Affymetrix ID	Mouse gene	Affymetrix ID
BACH2         227173, s.at         Bach2         1441657, at           BLK         206255, at         Blk         14422775, at           BTLA         236226, at         Blk         1455656, at           CCR6         206533, at         Ccr6         1450357, a, at           CCR7         206337, at         Ccr6         1423466, at           CD180         206206, at         Cd180         142547, at           CD22         217422, s, at         Cd22         1419769, at, 1419768, at           CD72         215925, s, at         Cd72         142816, at           CD74         205049, s, at, 1555779, a, at         Cd72         142818, at           CD84         211192, s, at, 21190, x, at         Cd80         142771, at, 143826, a, at           CD84         211192, s, at, 23500, at         Centbil         1455125, at, 1434814, x, at           CENTBI         20568, st, 20580, st         Centbil         1455125, at, 1434814, x, at           CENTBI         232000, st         Denofit         1419512, at, 1434814, x, at           DEWNDTC         20313, st, 235401, st, at, 23540, at         Ugrab         141980, at           T13LG         203805, st, at         Ge72         1442122, at           T4111         2335414<	ARHGAP4	204425_at	Arhgap4	1419296_at
BLK         206255_at         Blk         1422775_at           BTLA         236226_at         Bta         1425556_at           CCR6         206983_at         Cr7         1423466_at           CCR7         206337_at         Cr7         1423466_at           CD180         206206_at         Cr7         1423466_at           CD22         2114925_at         Cd22         1419766_at,1419768_at           CD33         242946_at         Cd22         1449766_at,1419768_at           CD72         215925_s_at         Cd72         1426112_a,at           CD74A         205049_s_at,12555779_a,at         Cd79a         1418830_at           CD74A         205149_s,at,235502_at         Cd84         1446505_at           CD760         1554519_at         Cd84         1446805_at           CD77         220132_s_at,233500_s,at,235522_at         Cerb1         1455125_at,134874_at           CLFC2D         220132_s,at,23340_at         Cerc2         1431840_at           DCN3         221602_s,at         Fcer2a         1442912_at           CFR1         235372_at,23540_s,at         Carc3         142212_at           CFR2         235372_at,23540_s,at         Gre72         1442115_a,at           CF	BACH2	227173 s at	Bach2	1441657 <sup>–</sup> at
BTLA         236226_at         Btla         145565_at           CCR6         206333_at         Ccr6         149357_a_at           CCR7         206337_at         Ccr6         140357_a_t           CD180         206206_at         Ccl180         1421547_at           CD22         217422_s_at         Cd23         1419769_at,141976_at           CD73         215925_s_at         Cd72         142617_at           CD74         215915_at         Cd79         1418830_at           CD74         215925_s_at         Cd79         1418830_at           CD84         211192_s_at,21190_x_at         Cd80         1427717_at,142826_a_at           CD84         211192_s_at,21190_x_at         Cd80         142044_at,144858_at           CEN7B1         20513_s_at,20505_at         CeR4         1419477_at           DCN3         221080_s_at,23522_at         Cerc2         1419478_at           DCN3         221080_s_at         25300_at         Dendit         1431840_at           DCN3         221080_s_at         25300_at         Dendit         1431840_at           DCN3         223057_s_at         26075_s         14421212_at         14421212_at           LCR2         202055_s_at         Fcr2a	BLK	206255 at	Blk	1422775 at
CR6         206883_st         Cr6         1490357_ast         Cr7         1423466_at           CD180         206206_st         Cr7         1421467_at           CD22         217422_sat         Cd150         1421577_at           CD23         242946_at         Cd22         1419769_at,1419768_at           CD74         20509_at,155779_a_at         Cd72         1426172_at         142867_at           CD74         20509_at,155779_a_at         Cd73         141830_at         CD84         1444505_at           CD84         21192_sat,21190_xat         Cd80         1427717_at,142826_ast         CD84         1444505_at           CD84         20568_sat,20568_sat         Cd86         1420404_at,1449506_at         Fabres           CD84         20190_sat         20513_at         Centb1         145125_at,134874_xat           CL8CD         20213_sat,23501_sat,23500_sat         Centb1         145125_at,1434874_xat           CL8CD         20213_sat         20670_s_sat         Faim3         1429889_sat           FCER1         206759_st,206760_s_sat         Fcer2a         1442152_at         1429889_sat           CER2         206759_st,206760_s_sat         Fcer3a         1422156_at         14429889_sat           CER2 <t< td=""><td>RTIA</td><td>236226 at</td><td>Btla</td><td>1455656 at</td></t<>	RTIA	236226 at	Btla	1455656 at
CR7         20633         at         Cr7         142346         at           CD180         206306_st         Cd180         1421547_at         CD22         217422_s at         Cd180         1421547_at           CD22         217422_s at         Cd123         1419769_st, 1419768_at         Cd22         1419769_st, 1419768_at           CD72         215925_s_at         Cd72         1426112_a_st         Cd72         142846_at           CD74         205049_s_at, 1555779_a_at         Cd72         1426112_a_t         Cd72         1428286_a_t           CD80         155519_s_at         Cd84         14476505_st         Cd84         14476505_st           CD84         21192_s_st, 21190_s_at         Cd84         1446505_st         Cd84         1449477_at           DC83         220579_st, 23500_st, at         Cereth         1445984_st         at           CER2         20132_st, 21, 23500_st, at         Fcer2a         1442989_st         fcER2           CD73         223807_st, 23540_st         Ger132         1442152_at         fcer2           CER2         20659_st, 26760_s, at         Fcer2a         1442215_at         fcer2           CR12         22380_st         Ger132         1442822_at         fcer13         f4	CCR6	206983 at	Ccrh	1450357 a at
CD 160         202006_att         Cd 180         142154_att           CD22         217422_s att         Cd22         1419769_at, 1419768_at           CD53         242946_att         Cd53         1439744_at           CD72         215925_s_at         Cd72         1426112_a           CD73         215925_s_at         Cd73         1418830_at           CD80         1554519_at         Cd73         1418430_at           CD84         21192_s_at, 20568_st         Cd80         142777.at, 14482826_aat           CD84         20513_at         Centb         145525_at, 1434874_s_at           CLENTB1         205213_at         Centb         145528_at, 1434874_s_at           CLENTB1         20525_at, 12030_at         Denditc         1431840_at           DOK3         223531_at, 22030_at         Denditc         1431840_at           DOK3         223531_at         Feim3         1429889_at           FCER2         206759_at, 206760_s_at         Feer2a         1421900_at           I127R         2235310_at         Ger13         1422982_at           I127R         2235310_at         Ger13         1442158_at           I127R         221605_s_st, 219971_at         I121r         1446266_at	CCR7	206337 at	Ccr7	1423466 at
CD2         114192_at         Cd22         14119769_at, 1414058_at           CD53         242946_at         Cd53         145974_at           CD72         215925_s_179_a_at         Cd72         1426112_a_at           CD74         205049_s_at, 1555779_a_at         Cd73         1428813_at           CD80         1554519_at         Cd84         1428050_st           CD84         211192_s_st, 211192_x_at         Cd84         1448658_at           CD86         205685_st, 205685_at         Cd86         1420404_at, 1449874_x_at           CLFC2D         22013_st, at, 235502_at         Clerch         1419477_at           DENDOTC         221032_st, at, 23500_at         Dendt         1431840_at           DCK3         22357_at, 23500_at         Dendt         1419096_at           FCRLM1         223372_at, 23540_at         Ger12         1442212_at           FCR14         223572_at, 20570_s, at         Fer2a         14122115_a, at           GCF72         233310_at         Ger12         1442233_at           IL12R         155258_st, 12971_at         IL174         1448433_at           IL21R         20586_s_at         IL174         1449045_at           IL724         204562_at, 129971_at         IL174	CD180	206206 at	Cd180	1421547 at
$ \begin{array}{ccccc} CD23 & 242946_{at} & CD2 & 11470_{at} 11470_{at} \\ CD53 & 242946_{at} & Cd53 & 1459744_{at} \\ CD72 & 215925_{s} at & Cd72 & 1426112_{a} at \\ CD73 & 20508_{s} at, 1555779_{a} at & Cd70 & 142777_{s} t, 143826_{s} at \\ CD84 & 21192_{s} at, 21190_{x} at & Cd80 & 142777_{s} t, 143826_{s} at \\ CD84 & 20586_{s} at, 20568_{s} at & Cd86 & 142040_{at} 143826_{s} at \\ CD86 & 20528_{s} at, 20520_{s} at & Cd86 & 142040_{at} 143828_{s} at \\ CL87 & 20521_{3} at & Centb & 145512_{s} at, 1434874_{s} at \\ CL87 & 2012_{s} at, 23500_{s} at, 23520_{s} at & Dendr & 141940_{s} at \\ DCN3 & 222553_{s} at, 20320_{at} & Deh3 & 141809_{6} at \\ DCN3 & 222553_{s} at, 20570_{s} at & Feim3 & 1428989_{at} \\ FCER2 & 206759_{s} at, 20570_{s} at & Feim3 & 1428989_{at} \\ FCER2 & 206759_{s} at, 20570_{s} at & Gerl2 & 144252_{s} at \\ FCRM1 & 235372_{at}, 235401_{s} at, 235400_{s} at & Gerl2 & 144252_{s} at \\ I173LG & 20680_{s} at & Hi31 & 1422115_{a} at \\ GCF12 & 233310_{at} & Gerl2 & 144252_{s} at \\ I176A & 205884_{at}, 205885_{s} at & II72b7 & 1418166_{a} at \\ I127R & 155258_{s} at, 21997_{at} & I127b7 & 1418166_{a} at \\ I127R & 204562_{a} at, 205885_{s} at & Irga4 & 1450155_{a} t \\ IrGAA & 205884_{a} at, 205885_{s} at & Irga4 & 1450155_{a} t \\ IrGAA & 205884_{s} at, 205885_{s} at & Irga4 & 144741_{a} t \\ At4172_{a} at \\ At40467 & 76897_{s} at & Cd2014M022hk & 144844_{a} t \\ At4175_{a} at \\ ICAA & 205986_{s} at & Irga4 & 143070_{a} t \\ LYP & 200370_{s} at, 221184_{s} at & Irgb7 & 141841_{a} t \\ LAA & C14 & 204562_{s} at, 210663_{s} at & Irga4 & 143070_{s} at \\ LYP & 200390_{s} at & Irga4 & 143007_{s} t \\ LYP & 200390_{s} at & Irga4 & 143077_{a} t \\ IFGA & 204980_{s} at & Irga4 & 14341_{a} t \\ IL7R & 1430570_{c} at & Irga4 & 143077_{c} at \\ IFGA & 204980_{s} at & Irga4 & 14310_{a} t \\ LYP & 201370_{s} at, 221124_{s} at & Irga4 & 14316_{a} at \\ INPA & 204986_{s} at & Irga4 & 143141_{a} t \\ INPA & 204986_{s} at & Irga4 & 143077_{s} at \\ IFGA & 204980_{s} at & Irga4 & 143077_{s} at \\ IFGA & 204980_{s} at & Irga4 & 143077_{s} at \\ IFGA & 20$	CD100	217422 c. at	Cd72	1/10760  at 1/10768  at
CDJ3         242-90_at         CDJ3         1425112_a_at           CD72         205049_s_at         1555779_a_at         Cd73a         1426112_a_at           CD74         205049_s_at         1555779_a_at         Cd73a         1418830_at           CD80         1554519_at         Cd84         14426112_a_at         1438265_at           CD84         211192_s_st_211190_x_at         Cd86         1420404_at, 1449874_x_at           CENT         200513_at         Centb1         1455125_at, 1449874_x_at           CENT         220132_s_t3, 23200_at         Dok3         1418096_at           DOK3         223532_s, at, 23200_at         Dok3         1429889_at           FCER2         206759_at, 206760_s_at         Fcer2a         1422115_a.at           CGET2         233310_at         Ger21         1442582_at           GCR12         23387_at         Gpr32         1444258_at           L127R         221658_s.at, 219971_at         I121r         149906_at           L127R         221658_s.at, 219971_at         I121r         1442182_at           L127R         221658_s.at         Inf4         1421172_at           I7664         20584 at, 20586_s.at         Inf4         1421717_at           L127R	CDZZ	217422_3_dt	CdE2	1419709_at, 1419708_at
CD/2         C1/32/3_still         CD/2         H2011/12_a at           CD73A         205043_at, 1555773_a_at         Cd73a         1418830_at           CD80         1554519_at         Cd73         1418430_at           CD84         21192_sat, 21190_x_at         Cd80         142777.at, 1434874_x_at           CD86         205213_at         Centb         145512_at, 1434874_x_at           CLECD         2012_sat, 23500_x_at, 23552_at         CleCd         1418430_at           DKN3         223553_s.at, 220320_at         Dok3         1418096_at           DK3         223572_at, 23600_s_at         Focr2a         1422115_a_at           DK3         223572_at, 23601_s_at         Focr2a         1422115_a_at           CER2         206759_at, 206760_s_at         Focr2a         1422115_a_at           CER2         206759_at, 206760_s_at         Focr2a         1422115_a_at           IL21G         202887_at         Gpr132         1444233_at           IL21R         1552584_at         1172b1         1418166_at           IL21R         1552584_at         1172b1         1418166_at           IL21R         15525at         117441_at         142117_at           IL21R         11552984_at         1172b1	CD33	242340_at	CdJJ CdZJ	1435744_dt
CD/3A         2050B3         2.d. 1753/19_at         CD/3A         1427717.at.142226.a.at           CD80         1554519.at         Cd80         1427717.at.142226.a.at           CD84         211192.s.at.211190.x.at         Cd86         1420404.at.144958.at           CD86         205666.s.at.205685.at         Centb1         145512.at.1434874.x.at           CLFC2D         220132.s.12330.x.at.235502.at         Centb1         145512.at.1434874.x.at           DENNDIC         220320.at         Denndic         1431840.at           DOK3         223530.st.2020.at         DoK3         1421927.at.           DCR1         235372.at.2520.at         Denndic         1431840.at           DCK3         223530.st.206760.s.at         Fccr2a         142212.at           FCER2         206759.at.206760.s.at         Fccr2a         142212.at           GCE72         235310.at         Gepr132         144258.at           CL7R         235370.at         GCG72         144358.at           IL2RB         1552584.at         II2rb1         1418166.at           IL2RB         1552584.at         II2rb1         1418166.at           IL2RB         205718.at         Ikgb7         1418741.at           KMA0674         76897.s.at	CD72	213923_3_dl	Cd70a	1420112_d_dl
CDB0         153459_at         CDB0         142/17_at         1424505_at           CDB4         2015865_st         CdB6         142004_st, 1432825_at         144505.at           CDB6         205213_st         CdB6         142004_st, 1432825_at         144505.at           CLEC2D         20132_st, 23500_x, at, 23552_at         Clec2d         145125_st, 143487_x, at           DKND         221080_st, at         Dok3         143980_at           DCK3         22353_st, 22030_at         Dok3         1429889_at           FCER2         206759_st, 20676_s_at         Feira3         1429889_at           FCER2         206759_st, 20676_s_at         Feira3         1429889_at           FCER2         206759_st, 20676_s_at         Fit31         1422115_a, at           GCET2         23387_at         Ger132         1442215_a, at           IL27R         155284_at         II12rh         1430456_at           IL27R         15258_st, 21997_at         IZ0014M02Rik         1414425           IL764         20656_s_at         Irf4         142113_at           ITGF4         204562_at         Itg67         1418741_at           IL27R         21531_s_at         Lat         1430057_at           IL764         2	CD79A	205049_5_dl, 1555779_d_dl	Cu/ya	1410050_dl
CD24         211192_X_at         CD46         1149505_at           CD266         2055665_at         20520552_at         Centb1         1455125_at         1434857_at_at           CLEC2D         220132_at         23350_at         23232_at         CleC2d         1419477_at           DENNDIC         221080_s at         Denndic         1418066_at         1418066_at           FALM3         221602_s at         Faim3         1429889_at         1418066_at           FCR2         206759_at, 200760_s.at         Fcer2a         1422122_at         1419178_at           GCET2         235310_at         Gere12         1442582_at         1419908_at           I12781         1525584_at         II127b1         1418166_at         141215_a_at           I12781         1525584_at         II271         1450456_at         14173_at           II76A4         205885_s.at         IfgA4         145105_at         1418166_at           I12781         221581_s.at         11824         143070_at         1418166_at           II76A4         205885_s.at         IfgA4         145105_at         143070_at           II76A         205718_at         Laga4         145103_at         1430570_at           IA74         204385_at, 210	CD80	1554519_dl		142//1/_dl, 1452626_d_dl
Cubo         205808_3_at, 20580_at, 20580_at, 20580_at, 20580_at, 20580_at, 20580_at, 20570_at, 20700_at, 20700_at, 20700_at, 20700_at, 20700_at, 2070_at, 20700_at, 2070_at,	CD84	211192_s_at, 211190_x_at	C084	
CENTRI         CENTRI         Test Status           CLECZD         220132_s_at, 23350_x_at, 23552_at         Clec2d         1419477_at           DENNDTC         221080_s_at         DenndTc         1431840_at           DCN3         223553_s.at, 220320_at         Dok3         1418096_at           FAIM3         221602_s_at         Faim3         1429889_at           FCER2         206759_at, 206760_s_at         Fere?a         1422115_a_at           GCET2         235310_at         Gert2         1442988_at           FLT3LG         20580_s_at         Fir33         1442215_a_at           GCET2         235310_at         Gert2         1444252_at           GCET4         242584_at         II/2rb1         1418166_at           IL27R         221581_s_at, 205885_sat         I/gp4         1445045_at           IGGA4         205884_at, 205885_sat         I/gp4         1445045_at           IGGA7         205718_at         I/gp4         1445015_at           IGA4         204385_at, 210663_sat         Kynu         1451903_at, 1430570_at           LA72         221581_sat         La62         1432616_a_at           LA27         221581_sat         La62         1432616_a_at           LA2800_sat		205080_s_at, 205085_at	Caso	1420404_at, 1449858_at
CLECZD         220132.s.at, 23300.x.at, 23532.at         Denn01c         141947/at           DENNDIC         221080.s.at         Denn01c         1431840.at           DOK3         222553.s.at, 220320.at         Dok3         1429889.at           FCER2         206759.at, 206760.s.at         Faim3         1429889.at           FCER1         235372.at, 235400.s.at         Uqcrb         1419908.at           FLT3LG         206980.s.at         FR131         1422115.a.at           GCET2         235310.at         Geet2         1442582.at           GCPR132         223887.at         Gpr132         1442582.at           IL21R         221685.s.at, 219971.at         II/21r         1450456.at           IR74         204562.at, 16686.s.at         Irf4         1425173.at           IG642         205884.st, 205885.s.at         Itgb7         1418741.at           KIAA0674         76897.s.at         C430014M02Rik         1441486.at           KYNU         204385.at, 21063.s.at         Kynu         1451903.at, 1430570.at           LAT2         221581.s.at         Lat2         1426169.a.at           LKYNU         204396.at         Lopep         1433907.at           LVPP         207904.s.at         Lopep <td< td=""><td>CENTRI</td><td>205213_at</td><td>Centol</td><td>1455125_at, 1434874_x_at</td></td<>	CENTRI	205213_at	Centol	1455125_at, 1434874_x_at
Definition         221080_5_at         Definition         141840_at           DOR3         22353_s.at, 220320_at         DoR3         141809_at           FAIM3         2211602_s.at         Faim3         1429889_at           FCER2         206759_at, 206760_s.at         Freiza         1422115_a.at           GCET2         235310_at         Gert2         1442232_at           GCET2         235310_at         Gert2         144252_at           I127R1         1552584_at         III/2rb1         1418166_at           IL27R1         221658_s.at, 219971_at         II21r         1450456_at           IRF4         204562_at, 216986_s.at         Irf4         14421173_at           ITG6A         205884_at, 20585_s.at         Irga4         1450155_at           ITGFA         204562_at, 216966_s.at         Kynu         1451903_at, 1430570_at           LAT2         21581_s.at         Lat2         1426169_a.at           LAT2         21124_x.at         Ly9         144965 at           LAT2         210370_s.at, 21124_x.at         Ly9         144916 at           MAPAK2         204936_at         Map4k2         1434833_at           MGC10986         218600_at         0610025L06Rik         1448077_at <td>CLEC2D</td> <td>220132_s_at, 233500_x_at, 235522_at</td> <td>Clec2d</td> <td>14194//_at</td>	CLEC2D	220132_s_at, 233500_x_at, 235522_at	Clec2d	14194//_at
DOK3         221502.s.at,         Z0320.s.at,         Faim3         1429889.at           FCER2         206759.at,         206780.s.at,         206782.at,         205718.at,         11217         145065.at,         1418041.at,         201702.at,         205718.at,         11217         145071.at,         201702.at,         205718.at,         11267         204793.at,         143007.at,         204705.at,         205718.at,         1426169.a, at,         206792.at,         204793.at,         1426169.a, at,         206792.at,         207904.at,         204936.at,         14261	DENNDIC	221080_s_at	Dennalc	1431840_at
PAIMS         221602_s_at         FaimS         1429889_at           FCER2         206759_at, 20570_s_at         Fcer2a         1422122_at           FCRLM1         235372_at, 235401_s_at, 235400_at         Uqorb         1419908_at           FLT3LG         206980_s_at         FIt3l         1422182_at           GCRT2         235310_at         Gcet2         1444238_at           I127R1         1525284_at         III/2b1         1418166_at           IL21R         221658_s_at, 219971_at         II21r         1450456_at           IIGGA4         205864_at, 205885_s_at         Itga4         1450155_at           ITGB4         205884_at, 205885_s_at         Itgb7         1418741_at           KIAA0677         76897_s_at         C430014M02Rik         144186_at           KYNU         204385_at, 210663_s_at         Lock         1457917_at           LAT2         221581_s_at         Lok         1457917_at           LVP         200490_s_at         Lok         143507_at           LVP         204936_s at         Map4k2         143483_at           MAPAK2         204960_s_at         Pics         1448027_at           LVP         204960_at         Picrcap         1448027_at	DOK3	223553_s_at, 220320_at	Dok3	1418096_at
FCER.Z         206759_at, 206760_s_at         Fcer2a         1422122_at           FCRLM1         235372_at, 235400_at         Uqrb         1419908_at           FLT3LG         206980_5_at         FL3I         1422115_a at           GCET2         235310_at         Gcet2         1442582_at           UL12RB1         1552584_at         UL12h1         1448166_at           UL2RB1         205806_s_at         UF2h1         1448166_at           UL2RB1         205868_s_t, 219971_at         UL2h1         1448166_at           UL2RB         20578_at, 205885_s_t         Ufgb7         1418741_at           KIAA0674         705897_s_t         C430014M02Rik         1441486_at           KYNU         204385_at, 21063_s_t         Lck         145103_at, 1430570_at           LAT2         221581_s_at         Lat2         1426169_a, at           LAT2         20130_s_t, 231124_x_at         Ly9         1449156_at           MAP4K2         204360_s_t, at         2010305B15Rik         1440673_at           NUPF3         155906d_at         Nup153         14441689_at           NCA3         209062_x_at         2010305B15Rik         144807_at           NUPF53         1559066_at         Nup153         1448027_at	FAIM3	221602_s_at	Faim3	1429889_at
FCRLM1     235372_at, 235401_s_at, 235400_at     Uqcrb     1419908_at       FLT3LG     206980_s_at     FH3I     1422115_a.at       GCET2     233810_at     Gcet2     1442582_at       GPR132     223887_at     Gpr132     1444233_at       L12RB     1552584_at     III2/b1     1418166_at       IL2RA     221658_s_at, 219971_at     II2/b1     1418146_at       IRF4     204562_at, 219971_at     II/f4     1421173_at       ITGA4     205884_at, 205885_s_at     Itgb7     1418741_at       ITGB7     205718_at     C430014002Rik     1441486_at       KIAA0674     76897_s_at     C430014002Rik     1441486_at       LAT2     221581_s_at     Lat2     1426169_a, at       LAT2     204890_s_at     Lock     1457917_at       LNPEP     207904_s_at     Lopep     1443907_at       LV9     214370_s_at, 231124_x_at     Ly9     1443907_at       LV9     244936_at     Map4k2     1434833_at       MAP4K2     204936_at     Nup153     1441689_at       NCOA3     209062_x_at     2010305815Rik     1448027_at       NUP153     1559064_at     Nup153     1441689_at       PIK3R5     227645_at, 220566_at     Pik3r5     1439480_at	FCER2	206759_at, 206760_s_at	Fcer2a	1422122_at
FLT3LG       206980_s_at       FH3J       1422115_a_at         GCET2       235310_at       Gcet2       1442582_at         GPR132       223887_at       Gpr132       1444258_at         L12RB1       1552584_at       II/12rb1       1418166_at         L121R       221658_s_at, 219971_at       II/2rb1       1450456_at         IRF4       204562_at, 216986_s_at       Irf4       1421173_at         ITG6A       205718_at       Itgp7       1418741_at         KIAA0674       76897_s_at       C430014M02Rik       1441486_at         KYNU       204385_at, 210663_s_at       Kynu       1451903_at, 1430570_at         LAT2       221581_s_at       Lat2       1426169_a_at         LK       204890_s_at       Lock       1457917_at         LNPEP       207904_s_at       Lopp       1443907_at         LV9       210370_s_at, 231124_x_at       Ly9       14431956_at         MGC10986       218600_at       0610025L06Rik       1460738_at         NCOA3       209062_x_at       2010305B15Rik       1448073_at         PAKS       227645_at, 220566_at       Pik3r5       1434980_at         PTRCAP       204960_at       Pik3r5       1434980_at	FCRLM1	235372_at, 235401_s_at, 235400_at	Uqcrb	1419908_at
GCET2         235310_at         Gcet2         1442582_at           QPR132         23387_at         Gpr132         144233_at           L12RB1         1552584_at         II12rb1         1418166_at           L121R         221658_s_at, 219971_at         II21r         1450456_at, 145045_at, 116986_s_at           IRF4         204562_at, 216986_s_at         Irf4         1421173_at           ITGB7         205718_at         Itgp4         1450155_at           ITGB7         204385_s_t, 210663_s_at         Kynu         1451903_at, 1430570_at           LAT2         221581_s_at         Lat2         1426169_a,at           LK         204385_st, 210663_s_at         Lnpep         1443907_at           LVP         207904_s_at         Lock         1449156_at           MAP4K2         204936_at         Map4k2         144383_at           MCO03         209062_xat         2010305B15Rik         14448027_at           NUP153         1559064_at         Nup153         1441698_at           PAX5         221969_at         Pax5         1459916_at           PK38B         219210_s_at         Rac2         1442802_at           PIK375         1434980_at         1445193_at           PAX5         2	FLT3LG	206980_s_at	Flt3l	1422115_a_at
GPR132         223887_at         Gpr132         1444233_at           L12RB1         1552584_at         II12rb1         1418166_at           L21R         221658_s_at, 219971_at         II12rb1         1418166_at           IRF4         204562_at, 216986_s_at         IrF4         1421173_at           ITGA4         205884_st, 205885_s_at         Irga4         1450155_at           ITGB7         205718_at         Irgb7         1418741_at           KIAA0674         76897_s_at         C430014M02Rik         1441486_at           KYNU         204385_at, 210663_s_at         Kynu         1451903_at, 1430570_at           LAT2         221581_s_at         Lat2         1426169_a_at           LKK         204890_s_at         Lock         1443307_at           LVPP         207904_s_at         Loppe         1443907_at           LVP9         210370_s_at, 231124_x_at         Ly9         1449156_at           MACO38         209062_x_at         2010025L06Rik         1460738_at           NUP153         1559064_at         Nup153         14460738_at           NUP153         159064_at         Pibrcap         1448511_at           RABB         219210_s_at         Rac2         1446033_at	GCET2	235310_at	Gcet2	1442582_at
IL12RB1       1552584_att       II12rb1       1418166_att         IL21R       221658_s_at, 219971_att       II21r       1450456_att         IR74       204562_at, 216986_s_at       Ir14       1421173_att         ITG6A4       205884_at, 205885_s_at       Itg4       1450155_at         ITGB7       205718_at       Itg47       1418741_att         KIAA0674       76897_s_at       C430014M02Rik       1441486_at         KYNU       204385_at, 210663_s_at       Kynu       1451903_at, 1430570_at         LA72       213511_s_at       Lat2       1426169_a_at         LK       2007904_s_at       Lock       1457917_at         LVPEP       207904_s_at       Ly9       1443907_at         LY9       210370_s_at, 231124_x_at       Ly9       1443907_at         MGC10986       218600_at       0610025L06Rik       1460738_at         NCOA3       209062_x_at       2010305815Rik       1448027_at         NUP153       1559064_at       Nup153       1441689_at         RA22       204960_at       Pik3r5       1434980_at         PTRCAP       204960_at       Pik3r5       1448151_at         RA68B       219210_s_at       Rac2       1440208_at	GPR132	223887_at	Gpr132	1444233_at
IL21R       221658_s_at, 219971_at       II21r       1450456_at         IRF4       204562_at, 216986_s_at       Irf4       1421173_at         ITGA4       205848_at, 205885_s_at       Itga4       1450155_at         ITGB7       205718_at       Itgb7       1418741_at         KIAA0674       76897_s_at       C430014M02Rik       1441486_at         KYNU       204385_at, 210663_s_at       Kynu       1451903_at, 1430570_at         LAT2       221581_s_at       Lat2       1426169_a_at         LVPEP       207904_s_at       Lnpep       1443907_at         LNPEP       207904_s_at       Ly9       1449156_at         MAP4K2       204936_at       Map4k2       143433_at         MGC10986       218600_at       0610025L06Rik       1448027_at         NUP153       1559064_at       Nup153       144880_at         PAX5       221969_at       Pax5       1459916_at         PIK3R5       227645_at, 220566_at       Pik3r5       143483_at         RAB8B       219210_s_at       Rac2       1440208_at         RAB8B       219210_s_at       Rac2       1440208_at         SLAMF1       206181_at       Slamf1       1425571_at         SLAMF7<	IL12RB1	1552584_at	ll12rb1	1418166_at
IRF4       204562_at, 2169865_at       Irf4       1421173_at         ITGA4       205884_at, 205885_s_at       Itga7       1418741_at         ITGB7       205718_at       Itgb7       1418741_at         KIAA0674       76897_s_at       C430014M02Rik       1418741_at         KYNU       204385_at, 210663_s_at       Kynu       1451903_at, 1430570_at         LAT2       21151_s_at       Lat2       1426169_a_at         LCK       2004890_s_at       Lock       1437917_at         LNPEP       207904_s_at       Lock       143907_at         LY9       210370_s_st_212124_xat       Ly9       1449156_at         MAP4K2       204936_at       Map4k2       1434833_at         MCOA3       20062_x.at       20103058158/ik       14460738_at         NCOA3       22064_at       Nup153       1441689_at         PAX5       221969_at       Pax5       1459916_at         PK375       244960_at       Ptprcap       1448511_at         RAC2       204960_at       Ptprcap       14486103_at         RAC2       204960_at       Samf1       1425571_at         SLAMF1       206181_at       Slamf1       1425571_at         SLAMF7       23430	IL21R	221658_s_at, 219971_at	ll21r	1450456_at
ITGA4       205884_at, 205885_s_at       Itga4       1450155_at         ITGB7       205718_at       Itgb7       1418741_at         ITGB7       205718_at       Itgb7       1418741_at         ITGB7       205718_at       Itgb7       1418741_at         ITGA7       204385_at, 210663_s_at       Kynu       1451903_at, 1430570_at         LAT2       221581_s_at       Lat2       1426169_a_at         LKX       204890_s_at       Lck       143907_at         LVP       207904_s_at       Lppep       1443907_at         LVP       210370_s_at, 231124_x_at       Ly9       1449156_at         MAP4K2       204936_at       Map4k2       1434833_at         MCOA3       209062_x_at       2010305B15Rik       1448027_at         NUP153       1559064_at       Nup153       1441689_at         PKX5       227645_at, 220566_at       Pik3r5       1434980_at         PTRCAP       204960_at       Ptprcap       1448511_at         RAB2B       219210_s_at       Rab2b       1440208_at         RAC2       207419_s_at       Slamf1       1425571_at         SLAMF1       20681_at       Slamf1       1429563_x_at         SP100       210219_	IRF4	204562_at, 216986_s_at	Irf4	1421173_at
ITGB7       205718_at       Itgb7       1418741_at         KIAA0674       76897_s_at       C430014M02Rik       1418741_at         KIAA0674       76897_s_at       C430014M02Rik       141846_at         KYNU       204385_st, 210663_s_at       Kynu       1451903_at, 1430570_at         LAT2       221581_s_at       Lat2       1426169_a_at         LCK       204890_s_at       Lnpep       143797_at         LNPEP       207904_s_at       Ly9       1449156_at         MAP4K2       204936_at       Map4k2       1434833_at         MGC10986       218600_at       0610025106Rik       146027_at         NUCOA3       209062_x_at       2010305B15Rik       14448027_at         NUP153       1559064_at       Nup153       1441689_at         PAX5       221969_at       Pax5       1439980_at         PTPRCAP       204960_at       Ptprcap       1448511_at         RA62       104003_at       Ra62       1440103_at         RA62       207419_s_at       Samf7       1433472_a_at         SLAMF1       206381_at       Solamf7       1433472_at         SP100       210219_at       Sp100       1451821_at         SP110       208861_at<	ITGA4	205884_at, 205885_s_at	ltga4	1450155_at
KIAA0674         76897_s_at         C430014M02Rik         1441486_at           KYNU         204385_at, 210663_s_at         Kynu         1451903_at, 1430570_at           LAT2         221581_s_at         Lat2         1426169_a_at           LCK         204890_s_at         Lck         1457917_at           LNPEP         207904_s_at         Lppep         1443907_at           LY9         210370_s_at, 231124_x_at         Ly9         14439156_at           MAP4K2         204936_at         Map4k2         1434833_at           MGC10986         218600_at         0610025L06Rik         1460738_at           NUP153         1559064_at         Nup153         1441689_at           PAX5         221969_at         Pax5         1459916_at           PIK3R5         227645_at, 220566_at         Pik3r5         1434980_at           PTRCAP         204960_at         Ptorcap         1448511_at           RABB         219210_s_at         Rab8b         1446103_at           RAC2         207419_s_at         Rac2         1440208_at           SLAMF1         206181_at         Slamf1         1425571_at           SLAMF7         234306_s_at         Slamf1         1425571_at           SPI-B	ITGB7	205718_at	ltgb7	1418741_at
KYNU         204385_at, 210663_s_at         Kynu         1451903_at, 1430570_at           LATZ         221581_s_at         Lat2         1426169_a_at           LCK         204980_s_at         Lck         1457917_at           LNPEP         207904_s_at         Lnpep         1443907_at           LY9         210370_s_at, 231124_x_at         Ly9         1443907_at           MAP4K2         204936_at         Map4k2         143833_at           MACC10986         218600_at         0610025L06Rik         1460738_at           NCCA3         209062_x_at         2010305B15Rik         1448027_at           NUP153         1559064_at         Nup153         1441689_at           PAX5         221969_at         Pax5         1434980_at           PRCAP         204960_at         Ptprcap         1444511_at           RAB8         219210_s_at         Rab8b         1446103_at           RHOF         1554539_a_at, 222812_s_at         LOC330189         1441510_at           SLAMF1         206181_at         Slamf1         1425571_at           SLAMF7         234306_s_at         Slamf7         1453472_a_at           SP100         210219_at         Sp100         1451821_a,at           Sept6	KIAA0674	76897_s_at	C430014M02Rik	1441486_at
LAT2       221581_s_at       Lat2       1426169_a_at         LCK       204890_s_at       Lck       1457917_at         LNPEP       207904_s_at       Lnpep       1443907_at         LY9       210370_s_at, 231124_x_at       Ly9       1449156_at         MAP4K2       204936_at       Map4k2       143833_at         MGC10986       218600_at       0610025L06Rik       1460738_at         NCOA3       209062_x_at       2010305B15Rik       1448027_at         NUP153       1559064_at       Nup153       1441689_at         PAX5       221969_at       Pax5       143980_at         PTRCAP       204960_at       Ptprcap       1448511_at         RAB8       219210_s_at       Rab8b       1446103_at         RAC2       207419_s_at       Rac2       1440208_at         SLAMF1       206181_at       Slamf1       1425571_at         SLAMF7       234306_s_at       Sp100       1451821_a_at         SP100       210219_at       Sp100       1451821_a_at         SP110       208861_at       Spi-b       1460407_at         SYK       209269_s_at       Syk       1457239_at         Sept6       212415_at, 241093_at, 212413_at       <	KYNU	204385_at, 210663_s_at	Kynu	1451903_at, 1430570_at
LCK         204890_s_at         Lck         1457917_at           LNPEP         207904_s_at         Lnpep         1443907_at           LY9         210370_s_at, 231124_x_at         Ly9         1449156_at           MAP4K2         204936_at         Map4k2         1434833_at           MGC10986         218600_at         0610025L06Rik         1460738_at           NUP153         1559064_at         Nup153         1441689_at           PAX5         221969_at         Pax5         1439916_at           PIX3R5         227645_at, 220566_at         Pik3r5         1434980_at           PTPRCAP         204960_at         Ptprcap         1448511_at           RAB8         219210_s_at         Rac2         144003_at           RAC2         207419_s_at         Rac2         1440208_at           RHOF         1554539_a_at, 222812_s_at         LOC330189         1441510_at           SLAMF1         206181_at         Sp100         1451821_a_at           SP100         210219_at         Sp100         1451821_a_at           SP110         208392_x_at         503141507Rik         1429562_at, 1429563_x_at           SP14         227552_at         Spt/b         1460407_at             SP17	LAT2	221581_s_at	Lat2	1426169_a_at
LNPEP         207904_s_at         Lnpep         1443907_at           LY9         210370_s_at, 231124_x_at         Ly9         1443907_at           MAP4K2         204936_at         Map4k2         1434833_at           MGC10986         218600_at         0610025L06Rik         14460738_at           NCOA3         209062_x_at         2010305B15Rik         1448027_at           NUP153         1559064_at         Nup153         144906_at           PAX5         221969_at         Pax5         1459916_at           PK3R5         227645_at, 220566_at         Pik3r5         1434980_at           PTRRCAP         204960_at         Ptprcap         1448511_at           RAB8B         219210_s_at         Rac2         1440208_at           RHOF         1554539_a_at, 222812_s_at         LOC330189         1441510_at           SLAMF1         206181_at         Slamf1         1425571_at           SLAMF1         206381_at         Sp100         1451821_a_at           SP100         210219_at         Sp100         1451821_a_at           SP110         208392_x_at         5031415C07Rik         1429562_at, 1429563_x_at           SP14         227552_at         Sept1         1448988_at	LCK	204890 s at	Lck	1457917 at
LY9       210370_s_at, 231124_x_at       Ly9       1449155_at         MAP4K2       204336_at       Map4k2       1434833_at         MGC10986       218600_at       0610025L06Rik       1460738_at         NCOA3       209062_x_at       201305B15Rik       1448027_at         NUP153       1559064_at       Nup153       1441689_at         PAX5       221969_at       Pax5       1459916_at         PIK3R5       227645_at, 220566_at       Pik3r5       1434980_at         PTPRCAP       204960_at       Pik3r5       1444003_at         RAB8B       219210_s_at       Rab8b       1446103_at         RAC2       207419_s_at       Rab8b       1441016_at         SLAMF1       206181_at       Slamf1       1425571_at         SLAMF7       234306_s_at       Slamf7       1453472_a_at         SP100       210219_at       Sp100       1451821_a_at         SP110       208392_x_at       5031415C07Rik       1429562_at, 1429563_x_at         SP102       212415_at, 241093_at, 212413_at       Sept1       1449898_at         Sept1       227552_at       Sept1       1449640_at         SP12       205864_at       Tbc1d1       1449665_at         TB	LNPEP	207904 s at	Lnpep	1443907 at
MAP4K2204936_atMap4k21434833_atMGC10986218600_at0610025L06Rik1460738_atNCOA3209062_x_at2010305B15Rik1448027_atNUP1531559064_atNup1531441689_atPAX5221969_atPax51459916_atPK3R5227645_at, 220566_atPik3r51434980_atPTPRCAP204960_atPtprcap1448511_atRAB8B219210_s_atRac21440208_atRAC2207419_s_atRac21440208_atRHOF1554539_a_at, 222812_s_atLOC3301891441150_atSLAMF1206181_atSlamf11425571_atSLAMF7234306_s_atSp1001451821_a_atSP100210219_atSp1001451821_a_atSP100210219_atSp1001451821_a_atSP100210219_atSpib-b1460407_atSYK209269_s_atSyk1457239_atSept1227552_atSept1144988a_atSept6212415_at, 24109_at, 212413_atSept6144565_atTRAF3IP3205804_s_atTraf1142360_atTRAF3IP3205804_s_atTraf1142360_atZRAF1205899_stTraf11434573_atTRAF3IP3205804_s_atTraf11434573_atZC3HAV1220104_atZc3hav1143199_atZVENI03231092_atZfan1321441985_at	LY9	210370 s at, 231124 x at	Lv9	1449156 at
MGC10986         218600_at         0610025L06Rik         1460738_at           NCOA3         209062_x_at         2010305B15Rik         1448027_at           NUP153         1559064_at         Nup153         1441689_at           PAX5         221969_at         Pax5         1459916_at           PIK3R5         227645_at, 220566_at         Pik3r5         1434980_at           PTPRCAP         204960_at         Ptprap         1448511_at           RAB8         219210_s_at         Rab8b         1446103_at           RAC2         207419_s_at         Rac2         1440208_at           RHOF         1554539_a_at, 222812_s_at         LOC330189         1441510_at           SLAMF1         206181_at         Slamf1         1425571_at           SLAMF7         234306_s_at         Slamf7         1453472_a_at           SP100         210219_at         Sp100         1451821_a_at           SP1-B         205861_at         Spi-b         1460407_at           SYK         209269_s_at         Syk         1457239_at           Sept1         227552_at         Sept6         1449888_at           Sept6         212415_at, 241093_at, 212413_at         Sept6         14449865_at           TRAF3IP3	MAP4K2	204936 at	Map4k2	1434833 <sup>–</sup> at
NCOA3         209062_x_at         2010305B15Rik         1448027_at           NUP153         1559064_at         Nup153         1441689_at           PAX5         221969_at         Pax5         1459916_at           PIK3R5         227645_at, 220566_at         Pik3r5         143980_at           PTPRCAP         204960_at         Ptprcap         1448511_at           RAB8         219210_s_at         Rab8b         1446103_at           RAC2         207419_s_at         Rac2         1440208_at           RHOF         1554539_a_at, 222812_s_at         LOC330189         1441510_at           SLAMF7         234306_s_at         Slamf1         1425571_at           SLAMF7         234306_s_at         Sp100         1451821_a_at           SP100         210219_at         Sp100         1451821_a_at           SP110         208392_x_at         5031415C07Rik         1429562_at, 1429563_x_at           SYK         209269_s_at         Syk         145739_at           Sept1         227552_at         Sept1         144988_at           Sept6         212415_at, 241093_at, 212413_at         Sept6         1445665_at           TBX21         205804_s_at         Traf1         14423602_at <tdt< td=""><td>MGC10986</td><td>218600<sup>_</sup>at</td><td>0610025L06Rik</td><td>1460738<sup>–</sup>at</td></tdt<>	MGC10986	218600 <sup>_</sup> at	0610025L06Rik	1460738 <sup>–</sup> at
NUP153         1559064_at         Nup153         1441689_at           PAX5         221969_at         Pax5         1459916_at           PIK375         227645_at, 220566_at         Pik375         1434980_at           PTPRCAP         204960_at         Ptprcap         1448511_at           RAB8         219210_s_at         Rab8b         1446103_at           RAC2         207419_s_at         Rac2         1440208_at           RHOF         1554539_a_at, 222812_s_at         LOC330189         1441510_at           SLAMF1         206181_at         Slamf1         1425571_at           SLAMF7         234306_s_at         Slamf1         1425571_at           SP100         210219_at         Sp100         1451821_a_at           SP110         208392_x_at         5031415C07Rik         1429562_at, 1429563_x_at           SP14         227552_at         Spk         14454472.ag           SYK         209269_s_at         Spk         1445989_at           Sept1         227552_at         Sept1         1449898_at           Sept6         212415_at, 241093_at, 212413_at         Sept6         1445665_at           TBX21         220684_at         Tbc1d1         1449361_at           TRAF3IP3	NCOA3	209062 x at	2010305B15Rik	1448027 at
PAX5       221969_at       Pax5       1459916_at         PIK3R5       227645_at, 220566_at       Pik3r5       1434980_at         PTPRCAP       204960_at       Ptprcap       1448511_at         RAB8B       219210_s_at       Rab8b       1446103_at         RAC2       207419_s_at       Rac2       1440208_at         RHOF       1554539_a_at, 222812_s_at       LOC330189       1441510_at         SLAMF1       206181_at       Slamf1       1425571_at         SLAMF7       234306_s_at       Slamf7       1453472_a_at         SP100       210219_at       Sp100       1451821_a_at         SP100       210219_at       Sp100       1451821_a_at         SP100       208392_x_at       5031415C07Rik       1429562_at, 1429563_x_at         SP10       208861_at       Spi-b       1460407_at         SYK       209269_s_at       Syk       1475239_at         Sept6       212415_at, 241093_at, 212413_at       Sept6       1445665_at         TBC1D1       1568713_a_at       Traf1       1423602_at         TRAF3IP3       205804_s_at       Traf3ip3       1434573_at         TRAF3IP3       205804_s_at       Traf3ip3       1434573_at	NUP153	1559064 at	Nup153	1441689 at
PIK3R5       227645_at, 220566_at       Pik3r5       1434980_at         PTPRCAP       204960_at       Ptprcap       1448511_at         RAB8B       219210_s_at       Rab8b       1446103_at         RAC2       207419_s_at       Rac2       1440208_at         RHOF       1554539_a_at, 222812_s_at       LOC330189       1441510_at         SLAMF1       206181_at       Slamf1       1425571_at         SLAMF7       234306_s_at       Slamf7       1453472_a_at         SP100       210219_at       Sp100       1451821_a_at         SP110       208392_x_at       5031415C07Rik       1429562_at, 1429563_x_at         SP10       1451821_a_at       Sp100       1451821_a_at         SP10       208392_x_at       5031415C07Rik       1429562_at, 1429563_x_at         SP11       208392_x_at       Sp1.b       1460407_at         SYK       209269_s_at       Syk       1457239_at         Sept6       212415_at, 241093_at, 212413_at       Sept6       1449888_at         Sept6       212415_at, 241093_at, 212413_at       Sept6       1449361_at         TRAF1       205804_s_at       Traf1       1423602_at         TRAF3IP3       205804_s_at       Traf3ip3       1434	PAX5	221969 at	Pax5	1459916 at
PTPRCAP         204960_at         Ptprcap         1448511_at           RAB8B         219210_s_at         Rab8b         1446103_at           RAC2         207419_s_at         Rac2         1440208_at           RHOF         1554539_a_at, 222812_s_at         LOC330189         1441510_at           SLAMF1         206181_at         Slamf1         1425571_at           SLAMF7         234306_s_at         Slamf7         1453472_a_at           SP100         210219_at         Sp100         1451821_a_at           SP100         208392_x_at         5031415C07Rik         1429562_at, 1429563_x_at           SP10         205861_at         Spib         1460407_at           SP10         205861_at         Spib         1460407_at           SP11         227552_at         Sept	PIK3R5	227645 at. 220566 at	Pik3r5	1434980 at
RABBB       219210_s_at       RabBb       1446103_at         RAC2       207419_s_at       Rac2       1446103_at         RHOF       1554539_a_at, 222812_s_at       LOC330189       1441510_at         SLAMF1       206181_at       Slamf1       1425571_at         SLAMF7       234306_s_at       Slamf7       1453472_a_at         SP100       210219_at       Sp100       1451821_a_at         SP100       208392_x_at       5031415C07Rik       1429562_at, 1429563_x_at         SP100       208392_x_at       5031415C07Rik       1449502_at, 1429563_x_at         SP100       208392_x_at       5031415C07Rik       1449502_at, 1429563_x_at         SP110       208392_x_at       Spi-b       1460407_at         SYK       209269_s_at       Syk       1457239_at         Sept1       227552_at       Sept1       1449898_at         Sept6       212415_at, 241093_at, 212413_at       Sept6       14447016_at         TBX21       220684_at       Tbc1d1       1449361_at         TRAF1       205804_s_at       Traf1       1423602_at         TRAF3IP3       205804_s_at       Treml2       1444718_at         WASPIP       202665_s_at       Waspip       1446905_at	PTPRCAP	204960 at	Ptprcap	1448511 at
RAC2       207419_s_at       Rac2       1440208_at         RHOF       1554539_a_at, 222812_s_at       LOC330189       1441510_at         SLAMF1       206181_at       Slamf1       1425571_at         SLAMF7       234306_s_at       Slamf7       1453472_a_at         SP100       210219_at       Sp100       1451821_a_at         SP100       208392_x_at       5031415C07Rik       1429562_at, 1429563_x_at         SP10       208392_x_at       5031415C07Rik       145962_at, 1429563_x_at         SP10       208392_x_at       5031415C07Rik       1429562_at, 1429563_x_at         SP10       205861_at       Spi-b       1460407_at         SYK       209269_s_at       Sept1       1449898_at         Sept1       227552_at       Sept6       14445665_at         TBC1D1       1568713_a_at       Tbc1d1       1449896_at         TBX21       20684_at       Tbx21       1449361_at         TRAF3IP3       205804_s_at       Traf3ip3       1434573_at         TREML2       219748_at       Treml2       1444718_at         WASPIP       202665_s_at       Waspip       1446905_at         ZC3HAV1       220104_at       ZC3hav1       1431909_at	RAB8B	219210 s at	Rab8b	1446103 at
RHOF       1554539_a_at, 222812_s_at       LOC330189       1441510_at         SLAMF1       206181_at       Slamf1       1425571_at         SLAMF7       234306_s_at       Slamf7       1453472_a_at         SP100       210219_at       Sp100       1451821_a_at         SP100       208392_x_at       5031415C07Rik       1429562_at, 1429563_x_at         SP10       208392_x_at       Sp100       1451821_a_at         SPI-B       205861_at       Spi-b       1460407_at         SYK       209269_s_at       Sept1       1449563_at_at         Sept1       227552_at       Sept1       1449898_at         Sept6       212415_at, 241093_at, 212413_at       Sept6       14449656_at         TBC1D1       1568713_a_at       Tbc1d1       1449361_at         TBX21       20684_at       Tbx21       1449361_at         TRAF1       205599_at       Traf1       142602_at         TRAF3IP3       205804_s_at       Traf3ip3       1434573_at         TREML2       219748_at       Treml2       1444995_at         ZC3H12D       1559263_s_at       Zc3h12d       145804_at         ZC3HAV1       220104_at       Zc3h2d       1445927 at       1426640 at	RAC2	207419 s at	Rac2	1440208 at
SLAMF1       206181_at       Slamf1       1425571_at         SLAMF7       234306_s_at       Slamf7       1453472_a_at         SP100       210219_at       Sp100       1451821_a_at         SP100       208392_x_at       5031415C07Rik       1429562_at, 1429563_x_at         SP10       208392_x_at       S031415C07Rik       1429562_at, 1429563_x_at         SP10       208392_x_at       Soj1415C07Rik       1429562_at, 1429563_x_at         SP10       208392_x_at       Soj1415C07Rik       1429562_at, 1429563_x_at         SP10       208392_x_at       Sojt       1460407_at         SYK       209269_s_at       Syk       1457239_at         Sept1       227552_at       Sept1       144988_at         Sept6       212415_at, 24109a_t, 212413_at       Sept6       1445665_at         TBC1D1       1568713_a_at       Tbc1d1       1449361_at         TBX21       20684_at       Tbx21       1449360_at         TRAF3IP3       205804_s_at       Traf3ip3       1434573_at         TREML2       219748_at       Treml2       1444718_at         WASPIP       202665_s_at       Waspip       1446905_at         ZC3HAV1       220104_at       ZC3hav1       1431909_at <td>RHOF</td> <td>1554539 a at. 222812 s at</td> <td>LOC330189</td> <td>1441510 at</td>	RHOF	1554539 a at. 222812 s at	LOC330189	1441510 at
SLAMF7       234306_s_at       Slamf7       1453472_a_at         SP100       210219_at       Sp100       1451821_a_at         SP110       208392_x_at       5031415C07Rik       1429562_at, 1429563_x_at         SPI-B       205861_at       Spi-b       1460407_at         SYK       209269_s_at       Syk       1457239_at         Sept1       227552_at       Sept1       1449898_at         Sept6       212415_at, 241093_at, 212413_at       Sept6       1445665_at         TBC1D1       1568713_a_at       Tbc1d1       1447016_at         TBX21       20684_at       Tbx21       1449361_at         TRAF1       205599_at       Traf1       142602_at         TRAF3IP3       205804_s_at       Traf3ip3       1434573_at         TREML2       219748_at       Treml2       1444095_at         ZC3H12D       1559263_s_at       Zc3h12d       1445005_at         ZC3HAV1       220104_at       Zc3h2d       1441098_at       1426640_at         ZC3HAV1       220104_at       Zc3h2d       1441098_at       1426640_at	SLAMF1	206181 at	Slamf1	1425571 at
SP100       210219_at       Sp100       1451821_a_at         SP110       208392_x_at       5031415C07Rik       1429562_at, 1429563_x_at         SPI-B       205861_at       Spi-b       1460407_at         SYK       209269_s_at       Syk       1457239_at         Sept1       227552_at       Sept1       1449898_at         Sept6       212415_at, 241093_at, 212413_at       Sept6       1445665_at         TBC1D1       1568713_a_at       Tbc1d1       1447016_at         TRXF1       205804_at       Tbx21       1449361_at         TRAF3IP3       205804_s_at       Traf11       1423602_at         TREML2       219748_at       Treml2       1444718_at         WASPIP       202665_s_at       Waspip       1445905_at         ZC3HAV1       220104_at       ZC3h12d       1445924_at         ZOHAV1       220104_at       ZC3h20       14573275_at	SLAME7	234306 s at	Slamf7	1453472 a at
SP110       208392_x.at       5031415C07Rik       1429562_at, 1429563_x_at         SPI-B       205861_at       Spi-b       1460407_at         SYK       209269_s_at       Syk       1457239_at         Sept1       227552_at       Sept1       1449898_at         Sept6       212415_at, 241093_at, 212413_at       Sept6       1445665_at         TBC1D1       1568713_a_at       Tbc1d1       1447016_at         TRAF1       205804_s_at       Traf1       1423602_at         TRAF3IP3       205804_s_at       Treml2       1444718_at         WASPIP       202665_s_at       Waspip       1445905_at         ZC3H12D       1559263_s_at       ZC3h12d       14431099_at         ZO3HAV1       220104_at       ZC3h2d       1445934_at	SP100	210219 at	Sp100	1451821 a at
SPI-B       205861_at       Spi-b       1460407_at         SYK       209269_s_at       Syk       1457239_at         Sept1       227552_at       Sept1       1449898_at         Sept6       212415_at, 241093_at, 212413_at       Sept6       1445665_at         TBC1D1       1568713_a_at       Tbc1d1       1447016_at         TBX21       220684_at       Tbx21       1449361_at         TRAF1       205804_s_at       Traf1       1423602_at         TREML2       219748_at       Treml2       1444718_at         WASPIP       202665_s_at       Waspip       1446905_at         ZC3H12D       1559263_s_at       Zc3h12d       1431909_at         ZC3HAV1       220104_at       Zc3hav1       1431909_at	SP110	208392 x at	5031415C07Rik	1429562 at 1429563 x at
SYK       209269_s_at       Syk       1457239_at         Sept1       227552_at       Sept1       1449898_at         Sept6       212415_at, 241093_at, 212413_at       Sept6       1445665_at         TBC1D1       1568713_a_at       Tbc1d1       1449361_at         TBX21       220684_at       Tbx21       1449361_at         TRAF1       205599_at       Traf1       142602_at         TRAF3IP3       205804_s_at       Traf3ip3       1434573_at         ZC3H12D       159263_s_at       Zc3h12d       14458504_at         ZC3HAV1       220104_at       Zc3hav1       1431909_at         ZVINIA3       221042_at       Zf5440_at       1445937_at	SPI-B	205861 at	Sni-b	1460407 at
Sint       120205_at       Synt       1149898_at         Sept1       227552_at       Sept1       1449898_at         Sept6       212415_at, 241093_at, 212413_at       Sept6       1445665_at         TBC1D1       1568713_a_at       Tbc1d1       1447016_at         TBX21       220684_at       Tbx21       1449361_at         TRAF1       205599_at       Traf1       142602_at         TRAF3IP3       205804_s_at       Traf3ip3       1434573_at         TREML2       219748_at       Treml2       1444718_at         WASPIP       202665_s_at       Waspip       1446905_at         ZC3H12D       1559263_s_at       Zc3h12d       145804_at         ZC3HAV1       220104_at       Zc3hav1       1431909_at         ZVINIA3       221092_at       Zfnp1a3       1441088_at	SYK	209269 s at	Svk	1457239 at
Septi       21795_att       Septi       144505_att         Septi       144505_att       Septi       144505_att         TBC1D1       1568713_a_att       Tbc1d1       1447016_att         TBX21       20084_att       Tbx21       1449361_att         TRAF1       205599_att       Traf1       1423602_att         TRAF3IP3       205804_s_att       Traf3ip3       1434573_att         TREML2       219748_att       Treml2       1444095_att         ZC3H12D       1559263_s_att       Zc3h12dt       145804_att         ZC3HAV1       220104_att       Zc3hav1       1431909_att	Sent1	227552 at	Sent1	1449898 at
TBC1D1     1568713_a_at     Tbc1d1     1447016_at       TBC1D1     1568713_a_at     Tbc1d1     1447016_at       TBX21     220684_at     Tbx21     1449361_at       TRAF1     205599_at     Traf1     1423602_at       TRAF3IP3     205804_s_at     Traf3ip3     1434573_at       TREML2     219748_at     Treml2     1444718_at       WASPIP     202665_s_at     Waspip     1446905_at       ZC3H12D     1559263_s_at     Zc3h12d     145804_at       ZC3HAV1     220104_at     Zc3hav1     1431909_at       ZVIEN143     221092_at     7fnp1a3     1441088_at	Sent6	212415 at 241093 at 212413 at	Septh	1445665 at
IEX21     IEX21     IEX21     IEX21     IEX21       TRAF1     20589_at     Traf1     1449361_at       TRAF3IP3     205804_s_at     Traf3ip3     1434573_at       TREML2     219748_at     Treml2     1444718_at       WASPIP     202665_s_at     Waspip     1446905_at       ZC3H12D     1559263_s_at     ZC3h12d     145804_at       ZC3HAV1     220104_at     Zc3hav1     1431909_at       ZVIEN143     221092_at     Zfon1a3     1441088_at     1426540_at	TBC1D1	1568713 a at	Thc1d1	1447016 at
TRAF1 $20509_{at}$ Traf1 $1423602_{at}$ TRAF3IP3 $205804_{s}_{at}$ Traf1 $1423602_{at}$ TREML2 $219748_{at}$ Treml2 $1444718_{at}$ WASPIP $202665_{s}_{at}$ Waspip $1445905_{at}$ ZC3H12D $1559263_{s}_{at}$ Zc3hav1 $1431909_{at}$ ZC3HAV1 $220104_{at}$ Zc3hav1 $1441088_{at}$ ZVISN143 $221092_{at}$ $76n123$ $1441088_{at}$	TRX21	220684 at	Thy21	1449361 at
TREAT     20555_at     Trafi     142502_at       TRAF3IP3     205804_s_at     Traf3ip3     1434573_at       TREML2     219748_at     Treml2     1444718_at       WASPIP     202665_s_at     Waspip     1446905_at       ZC3H12D     1559263_s_at     Zc3h12d     1458504_at       ZC3HAV1     220104_at     Zc3hav1     1431909_at       ZVIEN143     221092_at     7fm123     1441088_at	TRAF1	22000 <del>4</del> _at	Traf1	1473602 2+
TREML2     20504at     Treml2     1435/75_at       TREML2     219748_at     Treml2     1444718_at       WASPIP     202665_s_at     Waspip     1446905_at       ZC3H12D     1559263_s_at     Zc3h12d     1458504_at       ZC3HAV1     220104_at     Zc3hav1     1431909_at       ZVIEN143     221092_at     76p1123     1441088_at	TRAFSIPS	205555_at	Trafini	1 <u>4</u> 3 <u>4</u> 572 st
WASPIP         202665_s_at         Waspip         1446905_at           ZC3H12D         1559263_s_at         Zc3h12d         1458504_at           ZC3HAV1         220104_at         Zc3hav1         1431909_at           ZVIEN143         221092_at         Zfm123         1441088_at         1425640_at	TREMIO	200004_5_at	TromID	מוכירטיים. 1///710 st
VX351rr         202003_sat         VVabplp         1440905_at           ZC3H12D         1559263_sat         Zc3h12d         1458504_at           ZC3HAV1         220104_at         Zc3hav1         1431909_at           ZVIEN143         221092_at         Zfm123         1441089_at		213/40_dl 202665_c_2+	Machin	14447 10_dl
ZC3112D         133220_5_at         ZC3112U         143604_at           ZC3HAV1         220104_at         ZC3Hav1         1431909_at           ZNEN1A3         221092_at         76np1p3         1441098_pt	7024120	202003_3_al	vvasµiµ Zc2h12d	1440505_at
ZCJIMVI         ZCJIMVI         1431909_at           ZNENIA2         221009_at         7600122         1441092_at	7(24/1/1	2202_5_aL	702601120	1/21000 st
	ZNFN1A?	220104_at 221092 at	Zfnn1a?	1441088 at 1453378 at 1436649 at

This table lists all 62 predicted B-cell precursor genes using MiDReG with their Affymetrix ID in human U133 Plus 2.0 and mouse 430 2.0 platform.

### Table S2. Knockout phenotypes show defects in B-cell function and differentiation

Bach2	Failed to undergo efficient class-switch recombination (1)
Ccr6	B-cell numbers are reduced in Pever's patches from Ccr6-/- mice (2)
Ccr7	Impaired migration of Imphocytes (3)
Cd180	Impaired proliferative and humoral immune responses of <i>RP105</i> -deficient B cells to LPS (4)
Cd22	B cells from Cd22-deficient mice exhibited the cell surface phenotype and augmented intracellular calcium responses characteristic of chronically stimulated B cells, as occurs in SHP1-defective mice (5)
Cd72	In the bone marrow of Cd72-/- mice, there was a reduction in the number of mature recirculating B cells and an accumulation of pre-B cells (6)
Cd79a	In the absence of Iq-alpha, B-cell development does not progress beyond the progenitor stage (7)
Cd80	Provide costimulatory signal (8, 9)
Cd86	Mice lacking only B7-1 or B7-2 mounted high-titer antigen-specific IgG responses when immunized in complete Freund's adjuvant (10)
Dok3	Dok-3 restricts the intensity of Ca2+ signaling in B cells (11)
Fcer2a	Fcer2a-deficient mice show exaggerated IgE responses and airway hyper-responsiveness (12)
Flt3l	Significantly reduced numbers of myeloid and B-lymphoid progenitors were noted in the bone marrow of F/t3/-/- mice (13)
Gpr132	Abnormal expansion of both T and B lymphocytes (14)
ll21r	Mice deficient in the receptor for II-21 (II-21r) have normal lymphoid development; after immunization,
	these animals have higher production of the immunoglobulin IgE (15)
Irf4	Irf4-deficient B cells had impaired expression of activation-induced deaminase and lacked class-switch recombination (16, 17)
ltgb7	Lymphocyte trafficking to the gut (18, 19)
Lck	Reduced threshold for B-cell receptor (BCR) signaling in B1 cell (20, 21)
Ncoa3	Ncoa3-deficient mice have B-cell and T-cell hyperproliferative disorder, have hyperactivated NF-κB, and develop B-cell lymphomas (22)
Pax5	Complete block of early B-cell differentiation and altered patterning of the posterior midbrain in mice lacking Pax5/BSAP (23)
Ptprcap	T and B lymphocytes showed reduced proliferation in response to antigen receptor stimulation (24)
Rac2	Rac2 knockout mice show decreased B-cell lymphopoiesis, reduced BCR signaling, and reduced chemotaxis (25, 26)
Spi-B	Spi-B-/- mice exhibit severe abnormalities in B-cell function. Spi-B is essential for antigen-dependent expansion of B cells (27)
Syk	Syk-deficient fetal liver showed a block in B-cell development at the pro-B to pre-B-cell transition (28–31)
Tbx21	Tbx21 knockout mice show abnormal IgG2a class switching and IFN-gamma production (32, 33)
Waspip	Both Wip-deficient T and B cells show a profound defect in their subcortical actin filament networks.
	Wip is important for immunologic synapse formation and T-cell activation (34)
Znfn1a3	Aiolos-null mice have hyperactivated B cells (35)

41 genes were knocked out in mice out of the total 62 predicted B-cell precursor genes. Comprehensive review of the literatures identified 26 genes whose knockout phenotype show defects in B-cell function and differentiation. A short summary of this phenotype is listed here for each of the 26 genes.

## Table S3. Detailed classification of predicted B-cell genes

Cono	Mouse	B-cell	Catagory	Dubmod	Commont
Gene	KHOCKOUL	phenotype	Category	Publieu	
ARHGAP4 BACH2	Yes	Yes	Signal transducer Transcription	12181357,12115726, 18489790 15152264	<i>κB</i> -mediated cell survival (36–38) Failed to undergo efficient class-switch
BLK	Yes		factor Signal	14662906,	recombination (1) Involved in signaling downstream of the pre-BCR (39,
			transducer	10648608	40)
BTLA	Yes		Cell surface receptor	19155498, 12796776, 19342624, 15128774	<i>BTLA</i> regulates B-cell receptor signaling by targeting <i>Syk</i> and <i>BLNK</i> (41–44)
CCR6	Yes	Yes	Cell surface receptor	10843382	B-cell numbers are reduced in Peyer's patches from CCR6-/- mice (2)
CCR7	Yes	Yes	Cell surface receptor	10520991	Impaired migration of lymphocytes (3)
CD180 (RP105)	Yes	Yes	Cell surface receptor	10880523	Impaired proliferative and humoral immune responses of <i>RP105</i> -deficient B cells to LPS (4)
CD22	Yes	Yes	Cell surface receptor	8986715	B cells from CD22-deficient mice exhibited the cell surface phenotype and augmented intracellular calcium responses characteristic of chronically stimulated B cells, as occurs in SHP1-defective mice (5)
CD53			Cell surface receptor	17429843	<i>CD53</i> is a genetic target for early B-cell factor (45)
CD72	Yes	Yes	Cell surface receptor	10549631	In the bone marrow of CD72-/- mice, there was a reduction in the number of mature recirculating B cells and an accumulation of pre-B cells (6)
CD79A	Yes	Yes	Cell surface receptor	12097390	In the absence of Ig-alpha, B-cell development does not progress beyond the progenitor stage (7)
CD80	Yes	Yes	Cell surface receptor	11169445, 7694362	Provide costimulatory signal (8, 9)
CD84			Cell surface receptor	12115647	CD84 is expressed in B cells. Member of the CD2 subset of the la superfamily (46)
CD86	Yes	Yes	Cell surface receptor	9075931	Mice lacking only <i>B7-1</i> or <i>B7-2</i> mounted high-titer antigen-specific IgG responses when immunized in complete Freund's adjuyant (10)
CENTB1			Metabolic process	16256741, 17005562	Inhibits NF-kB and activates <i>ltgb1</i> recycling to control cell migration (47, 48)
CLEC2D	Yes		Cell surface receptor	18453569, 18782774	Expressed in B cells and can be stimulated through <i>TLR9</i> , surface Ig, or <i>CD40</i> . Possible role in B cells (49, 50)
DENND1C DOK3	Yes	Yes	Unknown Signal transducer	17290227, 17363732	No known function for this gene Dok-3 restricts the intensity of Ca2+ signaling in B cells (11)
FAIM3			Signal transducer	19703010	Inhibits Fas-mediated apoptosis (51). GC B cells are sensitive to Fas-mediated cell death. Indirectly connected to B cells
FCER2	Yes	Yes	Cell surface receptor	8041705, 8176203	FCER2A-deficient mice show exaggerated IgE responses and airway hyper-responsiveness (12)
FCRLM1			Cell surface receptor	12202404	Whereas no function is known for this, it appears to be only expressed in B cells. Previously predicted to have a B-cell function (52)
FLT3LG	Yes	Yes	Cytokine activity	10828034	Significantly reduced numbers of myeloid and B- lymphoid progenitors were noted in the bone marrow of <i>flt3L-/-</i> mice (13)
GCET2	Yes		Metabolic process	17489982, 16493007	Expressed in GC B cells and a very useful marker of B- cell lymphoma (53, 54)
GPR132	Yes	Yes	Cell surface receptor	11371358	Abnormal expansion of both T and B lymphocytes (14)
IL12RB1	Yes		Cell surface receptor	8977288, 9257825	Previously predicted to have a functional role in B cells. May have a functional role in IL12 signaling during the B-cell response (55, 56)
IL21R	Yes	Yes	Cell surface receptor	12446913	Mice deficient in the receptor for <i>IL-21</i> ( <i>IL-21R</i> ) have normal lymphoid development; after immunization, these animals have higher production of the immunocalchulin InF (15)
IRF4	Yes	Yes	Transcription factor	16767092, 8999800	<i>IRF4</i> -deficient B cells had impaired expression of activation-induced deaminase and lacked class- switch recombination (16, 17)

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	Mouse	B-cell			
Gene	knockout	phenotype	Category	Pubmed	Comment
ITGA4	Yes		Cell surface	12130787, 14645544	Role in marginal zone B-cell localization (57, 58)
ITGB7	Yes	Yes	Cell surface	17786243, 8684468	Lymphocyte trafficking to the gut (18, 19)
KIAA0674			Metabolic	16756961	Involved in neuronal development. No connection to B cells (59)
KYNU			Metabolic	14592712	Involved in tryptophan degradation. No connection
LAT2	Yes		Signal transducer	15477348, 15477350, 12486104, 12514734	LAT2 interacts with Grb2 to enhance BCR signaling (61–64)
LCK	Yes	Yes	Signal transducer	15972627, 15357954	Reduced threshold for BCR signaling in B1 cells (20, 21)
LNPEP	Yes		Metabolic	11884418	GLUT4 glucose uptake pathway. No obvious connection to B cells (65)
LY9	Yes		Cell surface receptor	16365421	Expression on B cells, T cells, macrophage, DCs, granulocytes. B-cell development, and activation appear normal. This gene may be redundant with other SLAM family members (66)
MAP4K2	Yes		Signal transducer	7477268, 7515885, 19246396	GCK is important for JNK/p38-mediated inflammation in macrophages. This gene is expressed in GC B cells (67–69)
MGC10986			Signal transducer	17699795	This gene has unknown function according to literature (70)
NCOA3	Yes	Yes	Signal transducer	16675958	NCOA3-deficient mice have B-cell and T-cell hyperproliferative disorder and hyperactivated NF- kb and develop B-cell lymphomas (22)
NUP153			Metabolic process		
PAX5	Yes	Yes	Transcription factor	8001127	Complete block of early B-cell differentiation and altered patterning of the posterior midbrain in mice lacking <i>Pax5/BSAP</i> (23)
PIK3R5	Yes		Signal transducer	17041586	PI3K signaling defects in neutrophils. B cells never examined before. Possible B-cell function (71)
PTPRCAP	Yes	Yes	Cell surface	9607926	T and B lymphocytes showed reduced proliferation in response to antigen recentor stimulation (24)
RAB8B			Signal	18701652	GLUT4 glucose uptake pathway. No obvious connection to B cells (72)
RAC2	Yes	Yes	Signal transducer	11907095, 18579797, 18579797	RAC2 knockout mice show decreased B-cell lymphopoiesis, reduced BCR signaling, and reduced
RUOF			Cinnal	18191593	Every second in D calls and hyperbornes (72)
RHUF			transducer	158/7/35	Expressed in B cells and lymphomas (73)
SLAMF1	Yes		Cell surface receptor	18055867	It is expressed on activated B cells. It is also expressed in LT-HSC (74). No identified B-cell function
SLAMF7	Yes		Cell surface receptor	17878365	SLAMF7 is up-regulated on activated B cells. Also, it induces proliferation and autocrine cytokine expression in B cells (75)
SP100			Transcription factor	16177824, 10921892	Associated with Bright, a B-cell-specific protein known to up-regulate BCR transcription in activated cells (76, 77)
SP110			Transcription factor	15308735, 16648851, 15815631	Mutations in human <i>SP110</i> cause severe T- and B-cell immunodeficiency (78–80)
SPI-B	Yes	Yes	Transcription factor	9384589	<i>Spi-B-I</i> - mice exhibit severe abnormalities in B-cell function. <i>Spi-B</i> is essential for antigen-dependent
SYK	Yes	Yes	Signal transducer	7477353, 12563261, 7477352, 18356083	<i>Syk</i> -deficient fetal liver showed a block in B-cell development at the pro-B to pre-B-cell transition
Sept1			Transcription	19043408	Known role in T-cell trafficking, but unknown
Sept6	Yes		Transcription factor	16314519	Common translocation partner to <i>MLL</i> in acute myeloid leukemia. No obvious role in B-cell function (82)
TBC1D1			Signal transducer	19740738	Involved in GLUT4 glucose uptake pathway. No obvious connection to B cells (83)

Gene	Mouse knockout	B-cell phenotype	Category	Pubmed	Comment
TBX21	Yes	Yes	Transcription factor	12882831, 15905519, 12766768, 18339657	<i>TBX21</i> knockout mice show abnormal IgG2a class switching and IFN-gamma production (32, 33)
TRAF1	Yes		Cell surface receptor	17405906, 19234489, 16622006, 11672546	TRAF1 knockout has T-cell hyperactivation (84). TRAF1 may be redundant for B-cell activation with other TRAFs (85, 86). It enhances CD40 signaling in combination with TRAF2 (87)
TRAF3IP3			Cell surface receptor	17868742, 18313334	Interacts with <i>Traf3</i> , a nuclear factor known to suppress B-cell survival by inhibiting NF-κB2 activation (88). Also associated with cell proliferation (89)
TREML2			Cell surface receptor	16670310	Expressed on all B-cell subsets, particularly high in B1 cells. Also expressed in neutrophils, peritoneal macrophages (90)
WASPIP	Yes	Yes	Metabolic process	11869681	Both WIP-deficient T and B cells show a profound defect in their subcortical actin filament networks. WIP is important for immunologic synapse formation and T-cell activation (34)
ZC3H12D			Metabolic process	17854321, 18178554	Some tumor suppressor activity, and associated with B-cell lymphomas (91, 92)
ZC3HAV1			Metabolic process		No known function
ZNFN1A3	Yes	Yes	Transcription factor	9806640	Aiolos-null mice have hyperactivated B cells (35)

This table describes the detailed association of predicted B-cell genes to B-cell function and differentiation. Out of 62 predicted genes, 41 mouse knockouts were published in the literature. Out of 41 knockouts, 26 genes have a B-cell phenotype. Out of 62 genes, 9 other genes have B-cell functions according to other experiments, and 5 genes have indirect connections to B-cell functions.

#### Table S4. Predicted role of GLUT4 pathway in B cell

Gene	Mouse knockout	B-cell phenotype	Category	Pubmed	Comment
TBC1D1			Signal transducer	19740738	Involved in GLUT4 glucose uptake pathway. No obvious connection to B cells (83)
RAB8B			Signal transducer	18701652	GLUT4 glucose uptake pathway. No obvious connection to B cells (72)
LNPEP	Yes		Metabolic process	11884418	GLUT4 glucose uptake pathway. No obvious connection to B cells (65)

The most interesting genes identified by MiDReG were those with unexpected connections to B-cell development and function. For example, three genes (*TBC1D1*, *RAB8B*, and *LNPEP*) identified by MiDReG to be up-regulated in B-cell development are known components of a pathway seemingly unrelated to B-cell function, the GLUT4 glucose uptake pathway. GLUT4 is a glucose transporter normally sequestered in vesicles in muscle and adipose tissue. Upon insulin signaling, these vesicles are quickly fused to the plasma membrane leading to GLUT4 surface expression and rapid glucose uptake (93). GLUT4 surface levels are regulated by endocytic recycling (94). This endocytic recycling pathway bears some similarity to internalization of the BCR complex upon antigen encounter. When the BCR of a naïve B cell first encounters antigen, it is internalized through receptor-mediated endocytosis, and the antigen is processed and presented by MHC class II molecules on the cell surface for activation by Th2 helper T cells. Both BCR and GLUT4 endocytosis have clathrin-mediated pathways. In addition, both insulin and BCR signaling involve tyrosine kinase, PI-3 kinase, Protein Kinase C, Akt, Rho, and Rab GTPases, and Ca<sup>2+</sup> flux (93, 95). The prediction of genes specific to the GLUT4 exocytic pathway in B cells leads to the surprising but testable hypothesis that genetic components important for GLUT4 endocytosis are also functionally important for BCR endocytosis. The identification of these genes and the prediction of similarities between GLUT4 and BCR endocytosis would not have been possible without MiDReG.

Antigen	Clone	Conjugate	Source	Population
Ly6c	AL-21	FITC	BD Pharmingen	CLP, Fr.A, B
Flk2	A2F10	PE	eBioscience	CLP, Fr.A, B
CD19	1D3	PECy5.5	eBioscience	CLP, Fr.A, B
B220	6B2	PECy7	eBioscience	CLP, Fr.A, B
CD27	LG.7F9	APC	eBioscience	CLP, Fr.A, B
CD11c	N418	Alexa750-APC	eBioscience	CLP, Fr.A, B
BP-1 (Ly51)	6C3	Biotin	BD Pharmingen	CLP, Fr.A, B
IL7Ra	A7R34	Biotin	House	CLP, Fr.A, B
NK1.1	PK136	PECy5	eBioscience	CLP, Fr.A, B
	PK136	PECy7	eBioscience	CLP, Fr.A, B
lgD	11-26c	FITC	eBioscience	Fr.C, D, E
CD43	1B11	PE	BD Pharmingen	Fr.C, D, E
lgM		APC	eBioscience	Fr.C, D, E
CD23	B3B4	PE	eBioscience	T1, T2, mature B
lgM	II/41	PECy5	eBioscience	T1, T2, mature B
CD93 (AA4.1)	AA4.1	APC	eBioscience	T1, T2, mature B
CD3	2C11	PECy5	eBioscience	T1, T2, mature B
CD4	GK1.5	Pacific Blue	House	T1, T2, mature B
CD8	53.6.7	Pacific Blue	House	T1, T2, mature B
Ter119	TER119	Pacific Blue	House	T1, T2, mature B
CD11b		Pacific Blue	House	T1, T2, mature B
Gr1		Pacific Blue	House	T1, T2, mature B
Mac1	M1/70	PECy5	eBioscience	T1, T2, mature B
GL7	GL-7	biotin	eBioscience	GC
CD38	90	APC	eBioscience	GC
NP	NP	PE	Biosearch	GC
ckit	2B8	PECy7	eBioscience	HSC, MPP
	2B8	APCCy7	eBioscience	HSC, MPP
Sca1	E13-161-7	Alexa680	House	HSC, MPP
CD34	RAM34	Biotin	House	HSC, MPP
	RAM34	FITC	House	HSC, MPP
Streptavidin		Qdot605	Invitrogen	
Goat anti-rat		Alexa488	Invitrogen	

### Table S5. Antibodies used

House: conjugates made within the Weissman lab.

#### Table S6. Primers used for real-time PCR

Gene name	Forward primer (5' to 3')	Reverse primer (5' to 3')
Beta-actin	GTCTGAGGCCTCCCTTTT	GGGAGACCAAAGCCTTCATA
Aicda	GGGAAAGTGGCATTCACCTA	GAACCCAATTCTGGCTGTGT
Arhgap4	CCAGTCTGAGGCAGCTTACC	GCTGAGGTGAAGCAATAGGC
Bach2	CAGCCAAACTGTTCCAGTGA	GGTGATTATAAGCGCCTGGA
Cd19	TAGGTTCACAGGTCCCAAGG	ATCACCCCTTGCCTAAGACC
Cd53	CTGACTTGCTTTAAGGAAAACTGG	TTCCCTATAGAGCACCACGAA
Cd72	CTACGGCCTGCCAATTTTTA	AGAGTGAGGGAGTGCTGGAG
cKit	CATCCATCCAGCACAATCAG	TGACAAAGTCGGGATCAATG
Fcrlm1	GAAGCTGCATCTGGTGATGA	CACAGAAGCTCTCGGTCCTC
ll21r	ATGTGTCCATGTCCAGACCA	ATTTGCAAAGGAAGGGGACT
ltga4	CAGAGCCACACCCAAAAGTT	GGGCCACGTTCTCATCTTTA
ltgb7	GTACAGGCGCTTTGAGAAGG	TGTTGTCCTGCTTCCAGTTG
Ly9	AAAAAGACGGCACAAACACC	GGTAGGGGCTTTCAGGAGAC
Nup153	ATACTGGGGAGTTGGTGCTG	GGGCTTCTTCAACATGAGAAA
Pax5	TTGGAGGATCCAAACCAAAG	CTGATCTCCCAGGCAAACAT
Ptprcap	CCCATGCATGTTATGGTGAA	TGATGTAAGGGTGGGGTGAC
Sept6	TGCAGTCACAGAAGGGTTGA	AGGCCAACCATGAAAATGAT
Spi-B	CATGGGGTTGCAAAGAGTTT	GCAGAATCAGAACCCAGAGC
Syk	CCTCTCTGCACCCCAGACTA	ATCTGCAGTGGGTCAGTGTG
Tbc1d1	TGGGGAGTAATGAGGAAACG	CCCCCTTAAGTCCCAAATTC
Traf3ip3	TCTGAAGGAGGACTGGAGGA	GCTCTCCAGCTCTCTGTGCT
Waspip	CTCCAGCAGGGAGAAGATGA	CATTGCACATTTGGATCGTC
Zc3h12d	AGGCACCAAGAATGGATCAG	CAAGGCCGGCAAGTTTACTA
Ebf1	CCCTCCAACTGCAGTAGCTC	TCTGACAACTGGTGCGAAAG
Pax5	TTGGAGGATCCAAACCAAAG	CTGATCTCCCAGGCAAACAT
VpreB	CATGCTGCTGGCCTATCTCA	TACAGGAGAGGCGGATGGTG
Rag1	GAGGTTCCGCTACGACTCTG	TCTTGGGATCTCATGCCTTC
Lambda5	TGCTGCTGTTGGGTCTAGTG	CAGCTCTGCTCCTTTCTGCT
E2A	ACGGTTCTGGATGAGACAGG	AAGCAGGGAGCTGTTCAGTG

Cells were sorted into TRIzol (Invitrogen Life Technologies), and RNA was isolated according to manufacturer's instruction. cDNA was synthesized by using the Superscript III kit (Invitrogen Life Technologies) using random hexamers. Amplifications were performed by using SYBR Green PCR core reagents (Applied Biosystems), and transcript levels were quantified by using an ABI 7900 Sequence Detection Systems (Applied Biosystems). The mean ct value of triplicate reactions was normalized against the mean ct value of  $\beta$ -actin. Primers were used at 400 nM.