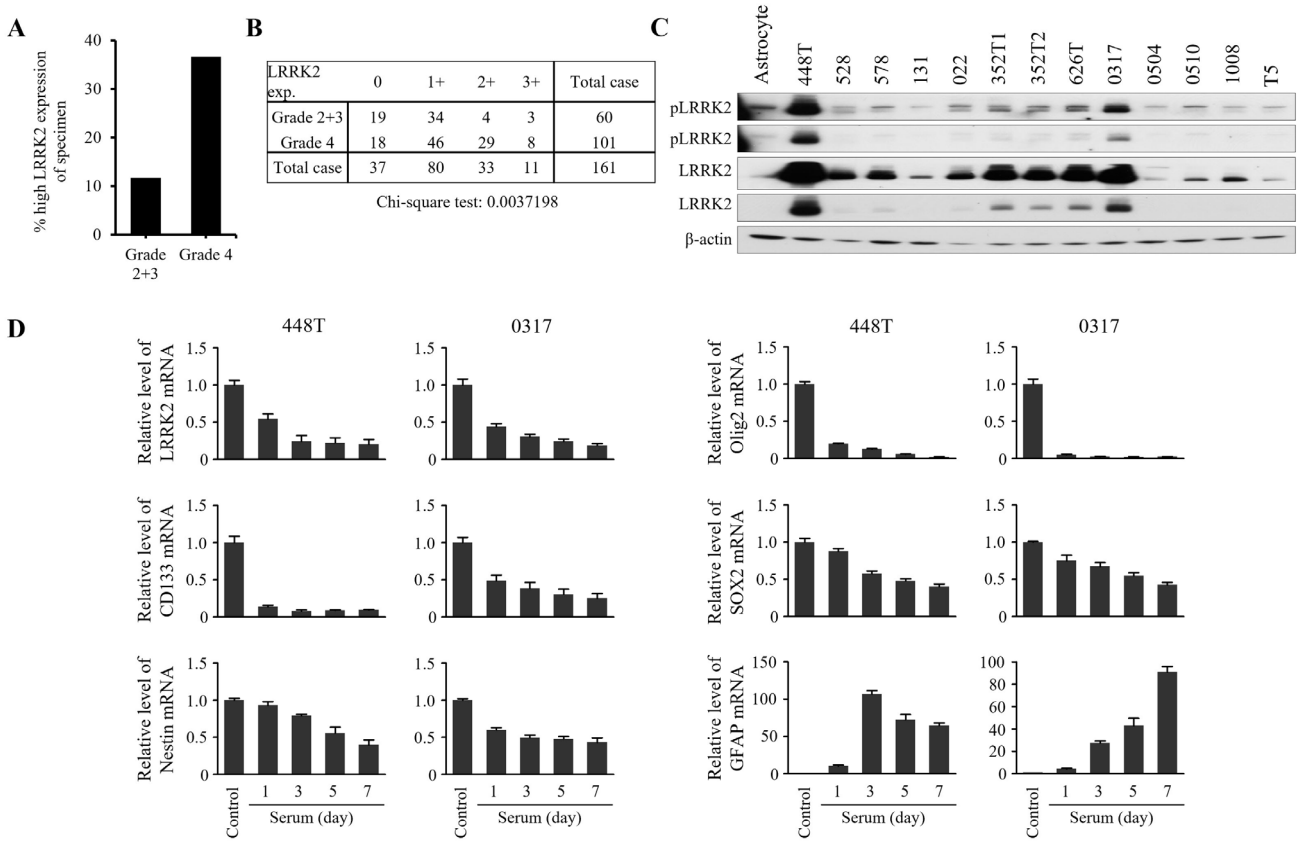
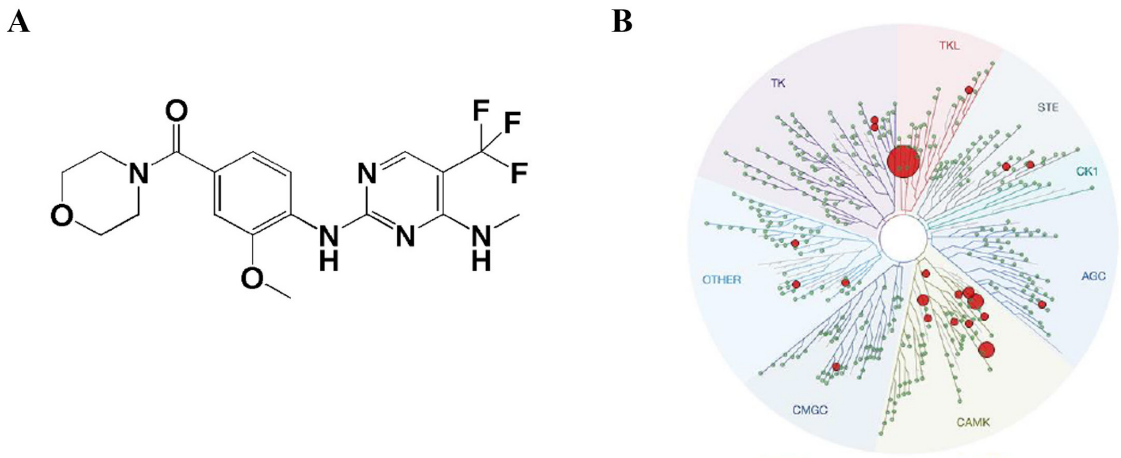


LRRK2 exp.	0	1+	2+	3+	Total case
Grade 2+3	19	34	4	3	60
Grade 4	18	46	29	8	101
Total case	37	80	33	11	161

Supplementary Fig. S1. Leucine-rich repeat kinase 2 (LRRK2) expression levels. (A, B) When assessing LRRK2 expression in the tissue microarray according to tumor grade in 161 patients, it was found that higher grades corresponded to increased LRRK2 expression. (C) After examining LRRK2 expression in astrocytes and patient derived glioma stem cells (GSCs), the 448T and 0317 cells, which showed high levels of pLRRK2 and LRRK2, were used for further analysis. (D) Upon differentiation of two GSCs (448T and 0317) using serum, the mRNA expression of LRRK2 and cancer stemness factors (CD133, Nestin, Olig2, SOX2) decreased, while the mRNA expression of the differentiation marker glial fibrillary acidic protein (GFAP) increased.



Supplementary Fig. S2. DNK72 as the blood-brain barrier (BBB) penetrating novel leucine-rich repeat kinase 2 (LRRK2) kinase inhibitor. (A) The structure of DNK72. (B) Kinase interaction maps for LRRK2 inhibitor, DNK72. Red circles indicate kinases bound, and circle size indicates binding affinity.

Supplementary Table S1. Gene list of Preranked GSEA EnrichmentMAP

Term	Genes	Count	NES	q-value
GO_MITOCHONDRIAL_GENE_EXPRESSION	*MRPL12|MRPS15|MRPL34|MPV17L2|SHMT2|MRPS5|DARS2|MRPL44|MRPL9|MRPS34|AURKAIP1|IARS2|MRPL14|MRPL55|MRPL22|NOA1|MRPL27|MRPS7|MRPL40|LARS2|MRPS25|MRPS35|MRPL53|CDK5RAP1|TARS2|MRRF|TRMT10A|GFM1|MRPS36|MTRF1|MRPL16|MRPL11|MRPL43|MRPL39|MRPS9|OXA1L|MRPS16|MRPS14|NSUN3|MRPL32|MRPS26|SARS2|MRPL46|POLRMT|MRPS27|MRPL17|MRPS12|ALKBH1|MRPL2|MRPL4|DAP3|MRPL38|MRPL51|MRPL23|RMND1|MRPS21|MRPL24|MRPS31|SUPV3L1|FOXO3|MRPL54|MRPS23|NGRN|MRPL33|TRUB2|RPUSD3|GFM2|MRPL47|ERAL1|MRPL13|PTCD3|MTIF3|MRPS2|COA3|MTO1|MRPS17|MRPS24|MRPS18B|NDUFA7|MRPL1|MRPL52|FASTKD3|AARS2|TRNT1|MRPL37|GADD45GIP1|CHCHD1|MTIF2|MRPS10|MRPL30|MRPL41|MRPS28|MRPS11|EARS2|MRPL18|RPUSD4|MRPS6|MALSU1|YARS2|RARS2|TFAM|TBRG4|PRKAA1|TRMT61B|NSUN4|GATC|MRPL3|MRPS33|TFB2M|SLC25A33|MRPL15|TEFM|MRPS18C|TUFM|LRPPRC|CHCHD10|MRPS18A|MRPL48|TSFM|MRPL45|MRPL21|MRPS30|WARS2|ELAC2|MRPL35|TRIT1|MRPL10|MRPS22|PUS1|MTG1|FASTKD2|MTRF1L|MRPL50|MRPL49|FASTKD5|MRPL42|QRSL1|TRMT5|MRPL20|HSD17B10|MRPL28|PNPT1|C1QBP|TRMT10C|MRPL19*	145	2.4129	0.0018
GO_MITOCHONDRIAL_TRANSLATIONAL_TERMINATION	*MRPL12|MRPS15|MRPL34|MRPL30|MRPL41|MRPS28|MRPS11|MRPL18|MRPS5|MRPL44|MRPS6|MRPL9|MRPS34|AURKAIP1|MRPL14|MRPL55|MRPL22|MRPL27|MRPL3|MRPS7|MRPL40|MRPS33|MRPL15|MRPS25|MRPS18C|MRPS35|MRPL53|MRPS18A|MRPL48|MRRF|MRPS36|MTRF1|MRPL16|MRPL45|MRPL11|MRPL43|MRPL39|MRPS9|OXA1L|MRPS16|MRPL21|MRPS30|MRPS14|MRPL32|MRPS26|MRPL46|MRPS27|MRPL17|MRPS12|MRPL35|MRPL2|MRPL4|DAP3|MRPL38|MRPL10|MRPL51|MRPL23|MRPS21|MRPS22|MRPL24|MRPS31|MTRF1L|MRPL50|MRPL54|MRPL49|MRPS23|MRPL33|GFM2|MRPL42|MRPL47|ERAL1|MRPL13|PTCD3|MRPL20|MRPS2|MRPS17|MRPS24|MRPS18B|MRPL28|MRPL1|MRPL52|MRPL37|MRPL19|GADD45GIP1|CHCHD1|MRPS10*	86	2.4115	0.0009
FARMER_BREAST_CANCER_CLUSTER_2	*MAD2L1|BUB1B|NEK2|CENPE|PRC1|TPX2|MCM4|CCNA2|RRS1|PRKDC|SLC25A32|ARMC1|RB1CC1|MRPL15|KIF20A|ASPM|ATAD2|BUB1|NUSAP1|PTTG1|KIF15|CCNB2|KIF4A|KIF11|NCAPG|CEP55|MELK|RAD54B|MTFR1|NDC80*	30	2.3643	0.0012
REACTOME_MITOCHONDRIAL_TRANSLATION	*MRPL12|MRPS15|MRPL34|MRPL41|MRPL30|MRPS28|MRPS11|MRPL18|MRPS5|MRPL44|MRPS6|MRPL9|MRPS34|AURKAIP1|MRPL14|MRPL22|MRPL55|MRPL27|MRPS7|MRPL40|MRPL3|MRPS33|MTFMT|MRPL15|MRPS25|MRPS18C|TUFM|MRPS35|MRPL53|MRPS18A|MRPL48|TSFM|MRRF|MRPS36|GFM1|MRPL16|MRPL45|MRPL43|MRPL11|MRPS9|MRPL39|OXA1L|MRPS16|MRPL21|MRPS14|MRPS30|MRPL32|MRPS26|MRPL46|MRPS27|MRPL17|MRPS12|MRPL35|MRPL2|MRPL4|DAP3|MRPL38|MRPL51|MRPL23|MRPL10|MRPL24|MRPS21|MRPS22|MRPS31|MTRF1L|MRPL50|MRPL54|MRPL49|MRPS23|MRPL33|GFM2|MRPL47|MRPL42|ERAL1|MRPL13|PTCD3|MRPL20|MTIF3|MRPS2|MRPS17|MRPS24|MRPS18B|MRPL28|MRPL1|MRPL52|MRPL37|MRPL19|GADD45GIP1|MRPS10|MTIF2|CHCHD1*	91	2.3273	0.0025
GO_TRANSLATIONAL_ELONGATION	*MRPL12|MRPS15|MRPL34|MRPS5|MRPL44|MRPL9|MRPS34|AURKAIP1|MRPL14|MRPL55|MRPL22|MRPL27|MRPS7|MRPL40|MRPS25|CPEB2|EEF2|MRPS35|MRPL53|GTPBP2|DPH1|GFM1|MRPS36|MRPL16|DPH5|MRPL11|MRPL43|MRPL39|MRPS9|EIF5A|OXA1L|MRPS16|ZNF598|MRPS14|MRPL32|MRPS26|LTN1|MRPL46|MRPS27|MRPL17|MRPS12|ALKBH1|MRPL2|MRPL4|DAP3|MRPL38|MRPL51|MRPL23|TRNAU1AP|MRPS21|MRPL24|MRPS31|MRPL54|MRPS23|EEF1A2|MRPL33|GTPBP1|MRPL47|ERAL1|MRPL13|EEF1A1|PTCD3|MRPS2|MRPS17|MRPS24|MRPS18B|RPLP2|MRPL1|MRPL52|MRPL37|GADD45GIP1|CHCHD1|MRPS10|DPH2|MRPL30|MRPL41|MRPS28|MRPS11|MRPL18|EEF1A1P5|MRPS6|SEPSECS|MRPL3|MRPS33|MRPL15|MRPS18C|TUFM|MRPS18A|MRPL48|TSFM|RPL30|EEFSEC|EIF4A3|MRPL45|MRPL21|MRPS30|SECISBP2|MRPL35|RPLP1|MRPL10|MRPS22|MRPL50|EEF1B2|MRPL49|EEF1G|EIF5A2|SECISBP2L|MRPL42|USP16|NEMF|MRPL20|MRPL28|HBS1L|EEF1D|MRPL19*	115	2.294	0.0026

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
GO_MITOCHONDRIAL_TRANSLATION	*MRPL12|MRPS15|MRPL34|MPV17L2|SHMT2|MRPS5|DARS2|MRPL44|MRPL9|MRPS34|AURKAIP1|IARS2|MRPL14|MRPL55|MRPL22|NOA1|MRPL27|MRPS7|MRPL40|LARS2|MRPS25|MRPS35|MRPL53|CDK5RAP1|TARS2|MRRF|GFM1|MRPS36|MTRF1|MRPL16|MRPL11|MRPL43|MRPL39|MRPS9|OXA1L|MRPS16|MRPS14|NSUN3|MRPL32|MRPS26|SARS2|MRPL46|MRPS27|MRPL17|MRPS12|ALKBH1|MRPL2|MRPL4|DAP3|MRPL38|MRPL51|MRPL23|RMND1|MRPS21|MRPL24|MRPS31|MRPL54|MRPS23|NGRN|MRPL33|TRUB2|RPUSD3|GFM2|MRPL47|ERAL1|MRPL13|PTCD3|MTIF3|MRPS2|COA3|MRPS17|MRPS24|MRPS18B|NDUFA7|MRPL1|MRPL52|FASTKD3|AARS2|MRPL37|GADD45GIP1|CHCHD1|MTIF2|MRPS10|MRPL30|MRPL41|MRPS28|MRPS11|EARS2|MRPL18|RPUSD4|MRPS6|MALSU1|YARS2|RARS2|NSUN4|GATC|MRPL3|MRPS33|MRPL15|MRPS18C|TUFM|LRPPRC|MRPS18A|MRPL48|TSFM|MRPL45|MRPL21|MRPS30|WARS2|MRPL35|MRPL10|MRPS22|MTG1|FASTKD2|MTRF1L|MRPL50|MRPL49|MRPL42|QRSL1|MRPL20|MRPL28|C1QBP|TRMT10C|MRPL19*	124	2.2828	0.0026
REACTOME_RRNA_MODIFICATION_IN_THE_NUCLEUS_AND_CYTOSOL	*RRP36|NOL6|TBL3|RPS9|THUMPD1|RCL1|FCF1|BMS1|RPS2|DHX37|KRR1|PNO1|NOC4L|DDX49|UTP3|WDR46|NOP14|DDX47|PDCD11|IMP4|TRMT112|WDR43|DIMT1|NAT10|RRP9|FBL|DKC1|NOL11|RRP7A|WDR75|RPS6|RPS7|TSR3|UTP6|WDR36|UTP14A|UTP20|RPS14|UTP15|GAR1|NOP56|HEATR1|EMG1|NOP58|IMP3|MPHOSPH10|NHP2|NOP2|UTP18|DCAF13|WDR3|NOP10|DDX52*	53	2.2712	0.0026
XU_HGF_SIGNALING_NOT_VIA_AKT1_48HR_DN	*MAD2L1|VPS41|WTAP|PLK1|CENPF|HMMR|LUC7L3|SRSF7|DLGAP5|GTSE1|IGFBP7|SRSF3|SPP1|KIF20A|SCD5|PPM1B*	16	2.2702	0.0023
GO_TRANSLATIONAL_TERMINATION	*MRPL12|GSPT2|MRPS15|MRPL34|ABCE1|OGFOD1|UPF1|MRPS5|MRPL44|APEH|MRPL9|MRPS34|AURKAIP1|MRPL14|MRPL55|MRPL22|MRPL27|MRPS7|MRPL40|MRPS25|MRPS35|MRPL53|MRRF|MRPS36|MTRF1|MRPL16|MRPL11|MRPL43|MRPL39|MRPS9|EIF5A|OXA1L|MRPS16|MRPS14|MRPL32|MRPS26|MRPL46|MRPS27|MRPL17|MRPS12|MRPL2|MRPL4|DAP3|MRPL38|N6AMT1|MRPL51|MRPL23|MRPS21|MRPL24|MRPS31|MRPL54|MRPS23|MRPL33|GFM2|MRPL47|ETF1|ERAL1|MRPL13|GLE1|PTCD3|MRPS2|MRPS17|MRPS24|MRPS18B|MRPL1|MRPL52|MRPL37|GADD45GIP1|CHCHD1|MRPS10|MRPL30|MRPL41|MRPS28|MRPS11|MRPL18|MRPS6|MRPL3|MRPS33|MRPL15|MRPS18C|MRPS18A|MRPL48|MRPL45|C12ORF65|MRPL21|MRPS30|TRMT112|MRPL35|GSPT1|MRPL10|MRPS22|MTRF1L|MRPL50|MRPL49|EIF5A2|MRPL42|MRPL20|MRPL28|MRPL19*	99	2.2554	0.0029
ROSTY_CERVICAL_CANCER_PROLIFERATION_CLUSTER	*BUB1B|MRPS15|NEK2|CENPM|DTL|GINS1|CCNE2|CHEK1|RAD51AP1|HMMR|GINS4|FEN1|SAC3D1|DSG2|PBK|ASF1B|CDC20|SLC38A1|MKI67|BID|FBXO5|KPNA2|ZWINT|PTTG1|EZH2|AURKB|DBF4|KIF4A|TMSB10|CDC6|CDK1|CEP55|RRM2|BRCA1|SLC25A15|CCNF|MYBL2|E2F1|MAD2L1|COMMD8|GMNN|CENPE|AURKA|E2F8|SMC4|TYMS|MCM2|TPX2|MCM4|EBP|PAQR4|KIFC1|UBE2C|TRIP13|KIF20A|ATAD2|PCNA|DPP3|HMGA1|TMPO|HMGB2|KIF23|NETO2|SHCBP1|CCNB1|TACC3|LMNB1|PLK1|HSPB11|SPDL1|DLGAP5|FANCI|GGH|NCAPH|POLA2|PRC1|DNMT3B|FOXM1|CDCA3|CCNA2|LRP8|STIL|BIRC5|OIP5|TOP2A|NUSAP1|CELSR3|KIF15|KIF20B|PAFAH1B3|ANP32E|TTK|SMC2|SPAG5|GTSE1|APOBEC3B|KIF14|DNA2|UBE2S|CENPF|RACGAP1|CKS2|LSM4|ESPL1|ACACA|KIF2C|CDCA8|CHAF1B|RPA3|EIF4EBP1|ASPM|BUB1|HELLS|CCNB2|KIF11|ECT2|KIF18B|NCAPG|MELK|HJURP|DTYMK|ERCC6L|MCM10|TK1|NDC80*	125	2.2305	0.0032
REN_BOUND_BY_E2F	*RAD51|POLA2|CHEK1|HMGB1|CDK2|CCNA2|FEN1|BRD2|NAP1L4|HMGB3|POLA1|RAD54L|RRM1|PRIM2|MLH1|TOP2A|RFC3|PTTG1|DBF4|CDC6|RB1|BARD1|CDK1|TTK|SMC2|UNG|UMPS|MAD2L1|DUT|CENPE|SMC4|MCM5|E2F3|TP53|MCM3|CSTF1|PRKDC|RFC2|RPA3|PCNA|RBL1|POLD1|CBX5|BUB3|SUPT4H1|HLTF|MCM6|MSH2|RFC4|TK1|ORC1|NDC80*	52	2.2155	0.0042

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
GO_ACTIN_FILAMENT_DEPOLYMERIZATION	*SWAP70|TMOD3|TMOD1|CAPZA1|SPTA1|CAPZA2|GSN|SEMA5A|EPS8|ACTN2|WDR1|PDXP|LIMA1|TMOD2|RDX|CAPZB|DSTN|PLEKHH2|MICAL2|PPP1R9B|ADD1|TWF2|TWF1|CFL2|SH3BP1|SPTAN1|TRIOBP|CFL1|SPTBN2|SPTBN1|CAPG|MICAL3|ADD3|MICAL1*	34	2.198	0.0055
GREENBAUM_E2A_TARGETS_UP	*ANLN|MKI67|SLC12A2|AURKA|BUB1|TOP2A|NUSAP1|CCNB1|SLC7A5|PFKP|RACGAP1|PTGS1|CCNB2|CCNA2|KIF11|KIF4A|ECT2|KIF2C|TTK|PGK1|HS3ST1|KLHDC2|EIF4EBP1*	23	2.1898	0.0058
KEGG_MISMATCH_REPAIR	*RFC1|PCNA|POLD3|POLD1|MLH1|EXO1|RPA1|RFC3|MLH3|LIG1|MSH3|POLD2|RFC5|SSBP1|RPA2|MSH2|RFC2|RFC4|RPA3|MSH6*	20	2.1738	0.007
WHITEFORD_PEDIATRIC_CANCER_MARKERS	*RECQL4|CCDC34|NEK2|NCAPH|CDCA7|CDCA2|GAPDH|PRC1|CDCA5|GPX7|RRP1|CKS1B|CCNA2|PSAT1|NME1|PBK|CDK6|ASF1B|HAUS1|HMGB3|BIRC5|MFN2|MKI67|CDC45|KPNA2|TOP2A|NUSAP1|RFC3|ZWINT|PTTG1|STMN1|MLLT11|UBE2T|LMNB2|DBF4|PAFAH1B3|CDK1|TTK|RRM2|SNRNP200|EIF4A1|BCAT1|SLC25A40|MYBL2|NUDT1|RNASEH2A|E2F1|MAD2L1|KIF14|ILF3|CENPE|AURKA|MCM5|SMC4|TYMS|ZNF367|NUF2|MND1|CENPN|TPX2|CENPF|MCM4|UHRF1|CKS2|ESPL1|ADCY3|NASP|ILF2|UBE2C|CDCA8|POLE2|EIF4EBP1|ATAD2|PCNA|CDK4|DNMT1|CCNT1|ENO1|TMPO|BUB1|MCM7|CCNB1|CCNB2|KIF11|DLGAP5|RCC2|CKAP2|GINS2|MELK|SOX4|DTYMK|TUBA1A|MEX3B|RFC4|TK1|GGH*	96	2.1677	0.0072
GO_CELLULAR_PROTEIN_COMPLEX_DISASSEMBLY	*MRPL12|SWAP70|NCKAP5L|MRPS15|GSPT2|MRPL34|ABCE1|OGFOD1|UPF1|MRPS5|MRPL44|APEH|NSF|MRPL9|MRPS34|AURKAIP1|SEMA5A|WDR1|LIMA1|GAK|MRPL14|MRPL55|MRPL22|MRPL27|MRPS7|MRPL40|CAPZB|MRPS25|MRPS35|PPP1R9B|MRPL53|PEX14|STMN1|MRRF|MRPS36|MTRF1|MRPL16|MRPL11|MRPL43|MRPS9|MRPL39|EIF5A|OXA1L|MRPS16|SPTBN1|KIF24|MRPS14|MRPL32|MRPS26|MRPL46|VPS4B|MICAL1|MRPL17|MRPS27|TMOD1|MRPS12|MRPL2|MRPL4|NAPA|DAP3|SH3GL1|GSN|MRPL38|HDAC6|MID1|N6AMT1|MRPL51|MRPL23|MRPL24|MRPS21|MRPS31|PDXP|MID1IP1|MRPL54|MRPS23|RDX|MAP1S|MRPL33|PLEKHH2|CAMSAP2|MICAL2|GFM2|MRPL47|ETF1|ERAL1|KATNB1|MRPL13|STMN3|TWF2|TWF1|CFL2|PTCD3|GLE1|MRPS2|SPTBN2|ARHGEF2|MRPS17|MRPS24|CIB1|MRPS18B|MAP1B|MRPL1|MRPL52|SYNJ1|MRPL37|GADD45GIP1|MRPS10|CHCHD1|MRPL30|MRPL41|CAPZA1|MRPS28|CLASP2|MRPS11|MRPL18|KIF18A|CAPZA2|MRPS6|ACTN2|ASPH|CCSAP|TMOD2|MRPL3|MRPS33|DSTN|MRPL15|MRPS18C|MAP1A|CAMSAP1|SH3BP1|MRPS18A|SPTAN1|MRPL48|NAPB|TRIOBP|MRPL45|C12ORF65|CKAP5|MRPL21|NES|MRPS30|CAPG|KIF2A|MICAL3|TRMT112|TMOD3|SPTA1|MRPL35|GSPT1|TAOK1|MRPL10|EPS8|MRPS22|MTRF1L|MRPL50|SPAST|KIF2C|MRPL49|HSPA8|VPS4A|EIF5A2|MRPL42|ADD1|CLASP1|MRPL20|CFL1|MRPL28|KIF18B|APC2|CKAP2|APC|ADD3|MRPL19*	173	2.1609	0.0074
REICHERT_MITOSIS_LIN9_TARGETS	*LMLN|CDK11B|ANAPC1|CENPE|AURKA|CDCA2|CENPF|HMMR|KIF2C|VCPIP1|KIF20A|ASPM|MKI67|FBXO5|HMGB2|TOP2A|KIF23|NUSAP1|CCNB1|PLK1|NCAPD2|MYO6|CEP55|CCNF|CALD1*	25	2.1425	0.0093

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
GO_RRNA_METABOLIC_PROCESS	*RPL14|RPS16|URB1|POP7|RIOK3|EXOSC8|DDX10|RRP1|FAM207A|YBEY|RPP38|RPS9|ZNHIT3|RPL7L1|XRN2|RPS2|ERI1|RPL35|NOC4L|DDX21|DIS3L|NOL9|TSR2|PELP1|SRFBP1|NSUN3|NGDN|WDR43|WDR12|BYSL|RRP9|EXOSC7|FTSJ3|SBDS|NOL11|RPL7|LYAR|KRI1|RPS28|RPS6|RPS7|RPS27|UTP14A|ESF1|CHD7|SART1|DROSHA|RPP25|NOP56|RPF1|NUDT16|ISG20L2|EXOSC3|EXOSC5|DDX52|RRNAD1|RRP36|TEX10|NOL6|RRS1|TRMT61B|NSUN4|PES1|RPL27|RPL26|WBP11|RCL1|FCF1|EXOSC6|EXOSC4|ERI3|RPUSD1|EXOSC1|EXOSC2|EXOSC10|NVL|RPF2|EIF4A3|DDX49|DDX47|EXOSC9|POP4|TFB1M|RPL35A|DIMT1|FBL|RBFA|RRP7A|DDX27|WDR75|UTP6|PA2G4|RPS8|ZCCHC4|NOP2|RRP15|TSR1|POP5|RPP40|ABT1|ZNHIT6|DDX51|RIOK2|METTL16|RIOK1|SENP3|RPL10A|PELO|FRG1|THUMPD1|C1D|DHX37|RPL7A|LAS1L|MAPT|UTP3|NOP14|NOL10|PIH1D1|NAF1|RSL1D1|METTL15|RPL11|DKC1|WDR55|ERCC2|MDN1|MPHOSPH6|WDR36|REXO4|RPUSD2|SUV39H1|NOLC1|GAR1|DDX54|MPHOSPH10|NHP2|RRP1B|RPS15|NSUN5|DDX56|RPS21|NOB1|MRTO4|MRPL1|RPS19|MRM1|MRPS11|LSM6|FBLL1|XRN1|WDR18|TBL3|DIS3|EBNA1BP2|GTPBP4|TFB2M|WDR74|BMS1|KRR1|ISG20|SHQ1|NSA2|WDR46|PDCD11|UTP23|RPS24|TRMT112|IMP4|NPM3|NAT10|HELQ|DDX18|TSR3|NOL8|BOP1|UTP20|RRP8|RPL5|RPS14|GEMIN4|UTP15|RPP30|HEATR1|EMG1|NOP58|IMP3|BTRC|UTP18|DCAF13|WDR3|NOP10|DDX17*	193	2.1214	0.012
GO_NEGATIVE_REGULATION_OF_ACTIN_FILAMENT_DEPOLYMERIZATION	*SWAP70|TMOD3|TMOD1|SPTA1|CAPZA1|ADD1|TWF2|TWF1|CAPZA2|SPTAN1|GSN|TRIOBP|EPS8|SPTBN2|LIMA1|SPTBN1|TMOD2|RDX|CAPG|CAPZB|PLEKHH2|ADD3*	22	2.12	0.0119
BURTON_ADIPOGENESIS_3	*NCAPH|RAD51|CDCA7|DTL|PRC1|CCNE2|RAD51AP1|FEN1|CX3CL1|ATF6B|CDC7|ASF1B|TFDP1|USP1|BIRC5|CDC20|POLA1|MKI67|RRM1|PNP|CDC45|KPNA2|TOP2A|NUSAP1|EZH2|BZW1|VCAN|KIF4A|CDC6|CDK1|TTK|RRM2|SMC2|BRCA1|CCNF|KIF22|TCF19|TUBB6|E2F8|MCM5|AURKA|TYMS|INCENP|TOPBP1|PRIM1|MCM2|MCM3|CSTF2|MCM4|RACGAP1|RFC5|SLCO3A1|CKS2|IMPDH2|KIF2C|LMO4|NASP|ILF2|CDCA8|KIF20A|DNMT1|NQO1|CENPK|FIGNL1|HMGB2|BUB1|NUP85|CCNB1|HELLS|SLBP|OSMR|TACC3|RNASEH2C|PLK1|CCNB2|KIF11|DLGAP5|DCK|DTYMK|MCM10|TK1|LRP5*	82	2.118	0.0115
FLORIO_NEOCORTEX_BASAL_RADIAL_GLIA_DN	*BUB1B|WEE1|NEK2|EXO1|CENPM|DTL|GINS1|CKAP2L|CDCA5|RAD51AP1|HMMR|SEMA5A|TGIF1|SPARC|MIS18BP1|SPC25|PBK|ACBD7|CDC20|FAM111A|MKI67|PHGDH|FBXO5|POC1A|KPNA2|HMGN2|PTTG1|ZWINT|AURKB|SKA1|ARHGAP11A|KIF4A|CDK1|RRM2|BRCA1|CENPL|HSD17B11|BLM|MYBL2|MAD2L1|KIF22|CENPE|AURKA|DSN1|E2F8|SMC4|MND1|NUF2|GEM|TPX2|SKA3|TIMELESS|TROAP|KIFC1|UBE2C|KIF20A|LDLR|ANLN|APOD|CENPK|HMGB2|KIF23|SHCBP1|CCNB1|KNTC1|LMNB1|TACC3|PLK1|NCAPD2|LRP4|FGFR2|DLGAP5|ELMO1|MSH5|FANCI|SLC15A2|NCAPH|CDCA2|EPB41L2|FN1|SERPINE1|KIF18A|PRC1|FOXM1|CDCA3|CKS1B|FSTL1|TFPI|FANCD2|BIRC5|RFTN2|CDC45|CEP152|GAS2L3|TOP2A|NUSAP1|KIF15|UBE2T|ANP32E|IQGAP3|TRAIP|TTK|NID1|SPAG5|GTSE1|BRIP1|CHEK2|PRR11|ATP9B|KIF14|NDE1|MCC|TUBB6|ESCO2|BRCA2|CENPF|RACGAP1|CKS2|ESPL1|KIF2C|CDCA8|ASPM|BUB1|CCNB2|ANXA1|KIF11|PSRC1|KIF18B|MAP7D3|CDKN3|CKAP2|ARHGAP19|HJURP|MELK|NCAPG2|EDNRB|TK1|NDC80*	138	2.1179	0.0109
GO_NEGATIVE_REGULATION_OF_PROTEIN_CONTAINING_COMPLEX_DISASSEMBLY	*SWAP70|TMOD3|TMOD1|PHF23|CAPZA1|SPTA1|CLASP2|CAPZA2|GSN|TAOK1|HDAC6|MID1|EPS8|LIMA1|MID1IP1|TMOD2|UBQLN4|CLEC16A|RDX|SCAF8|CAPZB|PLEKHH2|CAMSAP2|ADD1|CAMSAP1|KATNB1|CLASP1|TWF2|TWF1|SPTAN1|TRIOBP|SPTBN2|ARHGEF2|CIB1|MAP1B|SPTBN1|APC2|CKAP2|SCAF4|APC|CAPG|ADD3*	42	2.1068	0.0124
GO_MITOCHONDRIAL_RNA_PROCESSING	*ELAC2|CDK5RAP1|TRIT1|TRMT5|HSD17B10|TRMT10A|MTO1|PUS1|TBRG4|TRMT61B|SUPV3L1|PNPT1|TRMT10C|FASTKD5|TRNT1*	15	2.1009	0.013

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
SOTIRIOU_BREAST_CANCER_GRADE_1_VS_3_UP	*MRPL12|BUB1B|NEK2|EXO1|SHMT2|GINS1|CCNE2|ITCH|CHEK1|MIS18A|COX7B|HMMR|CDK2|FEN1|NME1|HMGB3|CDC20|MKI67|FBXO5|KPNA2|ZWINT|PTTG1|STMN1|EZH2|AURKB|KIF4A|GMPS|CDK1|CEP55|NUP93|RRM2|MYBL2|BLM|NUDT1|E2F1|MAD2L1|BYSL|TXNRD1|CENPE|AURKA|E2F8|DSN1|SNRPG|XPOT|DDX39A|PKMYT1|MCM2|TPX2|DNAJC9|MCM3|MCM4|VRK1|TIMELESS|TROAP|KIFC1|UBE2C|TXN|JMJD6|TRIP13|STIP1|KIF20A|TMPO|DONSON|CCNB1|TACC3|LMNB1|PLK1|MRPS17|MCM6|SLC52A2|POLR2K|DLGAP5|RAD54B|RFC4|RAD51|NCAPH|PDSS1|PRC1|FOXM1|CDCA3|SLC7A5|CCNA2|GTPBP4|MRPL15|STIL|BIRC5|CDC45|OIP5|SNRPF|TOP2A|NUSAP1|LAGE3|HCCS|KIF15|NUTF2|PFDN6|CENPI|TTK|PSMD12|SPAG5|GTSE1|TIMM10|PSMA7|RNASEH2A|APOBEC3B|KIF14|UBE2S|CMC2|CENPN|CCT5|CENPF|RACGAP1|CKS2|KIF2C|ESPL1|TUBA1C|CDCA8|ASPM|BUB1|UBE2N|CCNB2|KIF11|ECT2|KIF18B|NCAPG|CDKN3|HJURP|MELK|TUBA1A|MCM10|DSCC1|NCAPG2|NDC80|SNRPC*	134	2.1008	0.0125
REACTOME_PCNA_DEPENDENT_LONG_PATCH_BASE_EXCISION_REPAIR	*RFC1|PCNA|POLD3|POLD1|RPA1|RFC3|POLB|APEX1|LIG1|POLD2|POLE|RFC5|FEN1|POLE3|RPA2|RFC2|POLE4|POLE2|RPA3|RFC4*	20	2.0935	0.013
GO_RIBOSOME_BIOGENESIS	*GLUL|ABCE1|RPL14|GNL3L|RPS16|URB1|POP7|RIOK3|HEATR3|EXOSC8|DDX10|DDX3X|RRP1|AATF|FAM207A|URB2|MRPL22|YBEY|MRPS7|NLE1|RPP38|RPS9|DDX28|ZNHIT3|RPL7L1|XRN2|PTEN|PWP1|RPS2|CUL4A|ERI1|RPL35|NOC4L|DDX21|EIF2A|NOL9|MRPL11|TSR2|PELP1|SRFBP1|NSUN3|NGDN|WDR43|WDR12|BYSL|RRP9|RAN|RPL10|EXOSC7|FTSJ3|SBDS|NOL11|RPL7|RPL12|LYAR|KRI1|RPS28|RPS6|RPS7|RPS27|UTP14A|ESF1|CHD7|SART1|DROSHA|RPP25|NOP56|RPF1|NUDT16|ISG20L2|EXOSC3|EXOSC5|DDX52|EIF6|RPL24|RRNAD1|RRN3|RPS10|RRP36|BRIX1|TEX10|RPS5|NUP88|NOL6|RRS1|TRMT61B|NSUN4|PES1|RPL27|RPL26|SDAD1|WBP11|RCL1|FCF1|EXOSC6|EXOSC4|ERI3|RPUSD1|EXOSC1|GNL2|NPM1|EXOSC2|EXOSC10|NVL|RPF2|ZNF658|NOC2L|EIF4A3|DDX49|DDX47|EXOSC9|RPL6|RPL3|POP4|TFB1M|RPL35A|DIMT1|NMD3|FBL|RBFA|RRP7A|DDX27|WDR75|UTP6|RPLP0|PA2G4|RPS8|ZCCHC4|MRPL20|NOP2|RRP15|TSR1|POP5|RPP40|ABT1|XPO1|ZNHIT6|DDX51|MPV17L2|RIOK2|METTL16|NOP16|RIOK1|SENP3|RPL10A|FRG1|THUMPD1|C1D|GTF3A|TSC1|CUL4B|DHX37|RPL7A|LAS1L|GTPBP10|UTP3|NOP14|NOL10|PIH1D1|NAF1|RSL1D1|LTV1|METTL15|RPL11|DKC1|WDR55|ERCC2|MDN1|MPHOSPH6|WDR36|REXO4|RPUSD2|SUV39H1|NOLC1|GAR1|ERAL1|RPSA|DDX54|MPHOSPH10|NHP2|MRPS2|RRP1B|RPS15|SURF6|NSUN5|DDX56|RPL26L1|RPS21|NOB1|MRTO4|MRPL1|RPS19|MRM1|RPS27L|MRPS11|LSM6|FBLL1|PAK1IP1|MALSU1|WDR18|TBL3|DIS3|RPL3L|EBNA1BP2|GTPBP4|TFB2M|RSL24D1|WDR74|ZNF593|BMS1|KRR1|ISG20|SHQ1|NSA2|WDR46|DHX30|PDCD11|UTP23|RPS24|DDX31|CEBPZ|TRMT112|IMP4|NPM3|NAT10|HELQ|NIP7|MRPL10|FASTKD2|MYBBP1A|DDX18|TSR3|NOL8|BOP1|UTP20|RRP8|RPL5|RPS14|GEMIN4|UTP15|RPP30|ZNF622|HEATR1|EMG1|NOP58|IMP3|BTRC|UTP18|DCAF13|WDR3|NOP10|RPL23A|DDX17|C1QBP|NOM1|RPL38*	256	2.0923	0.0126
GO_BETA_CATENIN_TCF_COMPLEX_ASSEMBLY	*TCF7L1|TLE1|HDAC1|BCL9L|LEO1|CTNNB1|RBBP5|CREBBP|ASH2L|TLE4|KAT5|RUVBL1|TLE2|TRRAP|SMARCA4|EP300|LEF1|TLE3|TCF7|PYGO1|MEN1|TCF7L2|PYGO2|CDC73*	24	2.0848	0.0136
GO_POSITIVE_REGULATION_OF_HISTONE_METHYLATION	*RTF1|MTF2|SNW1|PHF1|DNMT3B|PAF1|CHTOP|LMNA|DNMT1|RIF1|WDR61|OGT|MECP2|PAXIP1|SIRT1|KPNA7|CTNNB1|EED|PHF19|AUTS2|SMAD4|BRCA1|BRD4|CTR9|RNF20*	25	2.0822	0.0134
GO_DNA_MODIFICATION	*ALKBH5|DNMT3B|ALKBH4|MIS18A|DMAP1|TDG|MBD4|MTRR|PRMT5|PIK3CA|EHMT2|GATAD2A|NTHL1|ASCC3|ALKBH3|ASCC1|MTA2|MPHOSPH8|EHMT1|PICK1|APOBEC3G|EXOSC6|EXOSC4|DDX4|CTCF|DNMT3A|ALKBH2|GSK3A|MECP2|TDRD5|EZH2|OTUD4|BRCA1|OGG1|UNG|NEIL2|ATRX|MGMT|APOBEC3B|ALKBH1|PRMT7|MUTYH|BEND3|ZMPSTE24|PARP1|APEX1|BAZ2A|N6AMT1|FTO|MPG|PPM1D|ATF7IP|RLF|TDRKH|MBD3|PIWIL2|DNMT1|KDM1B|TREX1|PARP2|TRIM28|TET2|USP9X|EXOSC3|ASCC2|EXOSC5|USP7|METTL4|GNAS|MBD2|SMUG1*	71	2.0753	0.0144

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
KANG_DOXORUBICIN_RESISTANCE_UP	*BUB1B|MAD2L1|POLA2|CENPM|AURKA|PRC1|GINS1|TYMS|FOXM1|RAD51AP1|TPX2|HMMR|MCM4|PBK|CDCA8|ASF1B|BIRC5|ASPM|CDC20|ATAD2|MKI67|RRM1|NQO1|OIP5|HMGB2|BUB1|TOP2A|NUSAP1|ZWINT|LMNB1|PLK1|KIF4A|CDC6|BARD1|CDK1|CDKN3|NCAPG|RRM2|HJURP|DTYMK|NCAPG2|DSCC1|RFC4|TK1|ABCC1|FANCI*	46	2.069	0.0153
GO_NCRNA_PROCESSING	*PUS3|TOE1|RPL14|INTS2|RPS16|URB1|POP7|RIOK3|EXOSC8|WDR4|DDX10|PARN|RRP1|TARBP1|FAM207A|YBEY|CDKAL1|RPP38|RPS9|MTFMT|THUMPD2|ZNHIT3|ZBTB8OS|RPL7L1|XRN2|RPS2|ERI1|RPL35|NOC4L|DDX21|PTCD1|TRMT10A|ELAC1|NOL9|TYW1|HNRNPA2B1|NSUN6|OSGEP|TSR2|PELP1|SRFBP1|THADA|NSUN3|SEPHS2|NGDN|INTS10|CTU1|WDR43|WDR12|GRSF1|BYSL|RRP9|METTL2B|EXOSC7|FTSJ3|SBDS|METTL2A|URM1|NOL11|INTS8|RPL7|LYAR|KRI1|RPS28|TSEN54|RPS6|RPS7|RPS27|PRKRA|PUSL1|METTL6|UTP14A|ESF1|CHD7|SART1|DROSHA|RPP25|ADAT1|NOP56|RNF113A|RPF1|NUDT16|MTO1|ISG20L2|BCDIN3D|EXOSC3|EXOSC5|DDX52|USB1|AARS2|RRNAD1|OSGEPL1|INTS1|RPUSD4|RRP36|TEX10|CLP1|NOL6|RRS1|TRMT61B|NSUN4|PES1|RPL27|RPL26|POP1|RPP14|KTI12|TARBP2|WBP11|RCL1|FCF1|EXOSC6|EXOSC4|ERI3|RPUSD1|EXOSC1|DUS3L|TRUB1|EXOSC2|EXOSC10|NVL|RPF2|GTPBP3|EIF4A3|METTL3|DDX49|PUS10|INTS7|DDX47|EXOSC9|TSEN34|POP4|TFB1M|RPL35A|DIMT1|METTL1|FBL|NSUN2|DUS1L|RBFA|RRP7A|DDX27|TSEN2|WDR75|ELP4|TRMT61A|UTP6|PA2G4|RPS8|ZCCHC4|TP53RK|INTS12|TRMT1L|SSB|METTL8|RPP21|NOP2|RRP15|TSR1|POP5|RPP40|ABT1|ALKBH8|ZNHIT6|TRMT10C|LCMT2|DDX51|RIOK2|MRPL44|METTL16|INTS6|RIOK1|TPRKB|SENP3|DGCR8|RPL10A|ELP6|ADAR|FRG1|THUMPD1|C1D|FTSJ1|SRRT|CDK5RAP1|C2ORF49|DHX37|RPL7A|LAS1L|UTP3|NOP14|NOL10|PIH1D1|MOCS3|NAF1|ELP2|THG1L|RSL1D1|METTL15|ALKBH1|RPL11|DKC1|WDR55|ERCC2|MDN1|MPHOSPH6|WDR36|REXO4|TRDMT1|DDX1|PUS7|RPUSD2|TRMT6|SUV39H1|NOLC1|INTS4|GAR1|DDX54|MPHOSPH10|NHP2|RRP1B|RPS15|NSUN5|DDX56|RPS21|NOB1|MRTO4|MRPL1|SMAD2|SMAD1|TRNT1|RPS19|MRM1|MRPS11|LSM6|FBLL1|WDR18|TBL3|DIS3|TRMT1|EBNA1BP2|ADAT2|ELP5|GTPBP4|TFB2M|INTS5|WDR74|TYW3|BMS1|KRR1|TUT1|LAGE3|ISG20|TRMT13|ADAT3|SHQ1|TRPT1|NSA2|DICER1|TRMT11|SEPHS1|THUMPD3|WDR46|PDCD11|UTP23|RPS24|ELP3|TRMT112|IMP4|NPM3|NAT10|HELQ|ELAC2|CTU2|TRIT1|INTS9|CSTF2|PUS1|ANKRD16|DDX18|TSR3|TSEN15|NOL8|INTS3|BOP1|UTP20|QTRT1|RRP8|RPL5|RPS14|GEMIN4|UTP15|RPP30|HEATR1|TRMT5|EMG1|NOP58|IMP3|HSD17B10|BTRC|UTP18|DCAF13|WDR3|NOP10|POLR3K|TYW5|SMAD3|CPSF1|DDX17|TRMU|FAM98B|CPSF4|FARS2*	312	2.0621	0.0163

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
GO_NCRNA_METABOLIC_PROCESS	*PUS3|TOE1|RPL14|AIMP2|RPS16|INTS2|URB1|RIOK3|POP7|EXOSC8|WDR4|DDX10|NARS2|PARN|IARS2|RRP1|TARBP1|FAM207A|YBEY|CDKAL1|XPO5|RPP38|RPS9|LARS2|MTFMT|THUMPD2|ZNHIT3|ZBTB8OS|NFKB1|RPL7L1|MARS2|XRN2|RPS2|TARS2|ERI1|RPL35|NOC4L|DDX21|PTCD1|DIS3L|TRMT10A|ELAC1|NOL9|DIS3L2|TYW1|HNRNPA2B1|FARSB|NSUN6|OSGEP|TSR2|PELP1|SRFBP1|THADA|NSUN3|SEPHS2|NGDN|INTS10|CTU1|WDR43|WDR12|GRSF1|BYSL|RRP9|RAN|METTL2B|EXOSC7|FTSJ3|SBDS|METTL2A|URM1|NOL11|INTS8|RPL7|LYAR|KRI1|RPS28|RPS6|TSEN54|RPS7|RPS27|PRKRA|PUSL1|AIMP1|METTL6|RC3H1|UTP14A|ESF1|CHD7|SART1|DROSHA|RPP25|ADAT1|NOP56|RNF113A|RPF1|NUDT16|MTO1|ISG20L2|DTD2|DALRD3|BCDIN3D|EXOSC3|EXOSC5|DDX52|USB1|AARS2|RRNAD1|OSGEPL1|INTS1|EARS2|RPUSD4|RRP36|CARS2|YARS2|TEX10|RARS2|CLP1|SEPSECS|NOL6|RRS1|TRMT61B|NSUN4|GATC|PES1|RPL27|RPL26|RPP14|KTI12|POP1|TARBP2|WBP11|RCL1|FCF1|EXOSC6|EXOSC4|ERI3|RPUSD1|EXOSC1|DUS3L|TRUB1|EXOSC2|EXOSC10|NVL|RPF2|GTPBP3|PARS2|VARS2|EIF4A3|METTL3|DDX49|INTS7|EXOSC9|PUS10|DDX47|PPA1|TSEN34|POP4|TFB1M|RPL35A|DIMT1|METTL1|FBL|NSUN2|DUS1L|RBFA|RRP7A|DDX27|TSEN2|WDR75|ELP4|TRMT61A|UTP6|RPS8|PA2G4|ZCCHC4|SND1|TP53RK|INTS12|TRMT1L|SSB|METTL8|RPP21|RC3H2|NOP2|RRP15|TSR1|POP5|RPP40|ABT1|ALKBH8|ZNHIT6|DTD1|TRMT10C|PPA2|LCMT2|DDX51|RIOK2|DARS2|MRPL44|METTL16|MEPCE|INTS6|RIOK1|TPRKB|SENP3|DGCR8|RPL10A|PELO|ELP6|ADAR|FRG1|THUMPD1|C1D|FTSJ1|SRRT|RELA|CDK5RAP1|DDX4|C2ORF49|DHX37|RPL7A|LAS1L|MAPT|UTP3|NOP14|NOL10|PIH1D1|MOCS3|NAF1|ELP2|THG1L|SARS2|RSL1D1|METTL15|ALKBH1|RPL11|DKC1|WDR55|ERCC2|MDN1|HARS2|KHSRP|MPHOSPH6|WDR36|REXO4|TRDMT1|DDX1|PUS7|RPUSD2|TRMT6|SUV39H1|NOLC1|INTS4|GAR1|DDX54|MPHOSPH10|NHP2|RRP1B|ZCCHC8|RPS15|NSUN5|DDX56|RPS21|RBM7|NOB1|MRTO4|MRPL1|SMAD2|SMAD1|TRNT1|RPS19|MRM1|MRPS11|LSM6|FBLL1|XRN1|WDR18|DIS3|TRMT1|TBL3|EBNA1BP2|ADAT2|ELP5|GTPBP4|TFB2M|INTS5|WDR74|TYW3|BMS1|KRR1|TUT1|LAGE3|FARSA|ISG20|TRMT13|ADAT3|SHQ1|TRPT1|NSA2|DICER1|TRMT11|SEPHS1|THUMPD3|WDR46|PDCD11|UTP23|RPS24|EEF1E1|ELP3|TRMT112|IMP4|WARS2|NPM3|NAT10|HELQ|ELAC2|CTU2|TRIT1|INTS9|CSTF2|PUS1|ANKRD16|DDX18|TSR3|TSEN15|NOL8|TDRKH|HRAS|INTS3|UTP20|QTRT1|BOP1|RRP8|RPL5|RPS14|UTP15|GEMIN4|PIWIL2|RPP30|QRSL1|HEATR1|TRMT5|EMG1|IMP3|NOP58|HSD17B10|BTRC|UTP18|DCAF13|WDR3|NOP10|POLR3K|TYW5|SMAD3|CPSF1|DDX17|PNPT1|TRMU|FAM98B|CPSF4|FARS2*	361	2.0551	0.0172
REACTOME_RMTS_METHYLATE_HISTONE_ARGININES	*ARID1B|JAK2|PRMT7|ACTL6A|RBBP7|CARM1|SMARCD1|PRMT3|SMARCD3|ARID2|WDR5|PRMT5|SMARCD2|PBRM1|ARID1A|PRMT1|CDK4|ACTL6B|WDR77|SMARCE1|SMARCA2|DNMT3A|RPS2|COPRS|PRMT6|SMARCC1|SMARCC2|SMARCB1|SMARCA4*	29	2.0481	0.0183
GO_NEGATIVE_REGULATION_OF_SUPRAMOLECULAR_FIBER_ORGANIZATION	*SWAP70|BBS4|CAPZA1|CLASP2|ARAP1|CAPZA2|ARFGEF1|CLIP3|PFN2|PRKCD|CLU|LIMA1|PPP1R9A|TMOD2|GMFB|CAPZB|MAPRE1|MYADM|PICK1|FKBP4|TUBB4A|CAMSAP1|SPTAN1|CORO2B|STMN1|MAP2|CORO1B|TRIOBP|KANK1|TMSB10|HIP1R|SPTBN1|SMAD4|APOE|CAPG|TMOD1|TMOD3|SPTA1|GSN|TAOK1|DYRK1A|HDAC6|PHLDB2|MID1|EPS8|INPP5K|MID1IP1|TMSB4X|PFN1|RDX|HSPA8|DLC1|PLEKHH2|TBCD|CAMSAP2|LDLR|ADD1|KATNB1|CLASP1|TWF2|TWF1|EMILIN1|EML2|SPTBN2|ARHGEF2|CIB1|MAP1B|APC2|CKAP2|PPFIA1|CORO1A|APC|ADD3|CRYAB|WASF2*	75	2.0415	0.0197
REACTOME_FORMATION_OF_THE_BETA_CATENIN_TCF_TRANSACTIVATING_COMPLEX	*TLE1|HDAC1|BCL9L|RBBP5|KAT5|RUVBL1|EP300|LEF1|TCF7|PYGO1|MEN1|TCF7L2|PYGO2|TCF7L1|TCF4|LEO1|CTNNB1|CREBBP|ASH2L|TLE4|TLE2|TRRAP|SMARCA4|TLE3|CDC73*	25	2.0333	0.0212

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
DUTERTRE_ESTRADIOL_RESPONSE_24HR_UP	*RECQL4|CENPO|GLA|CD320|SLC26A2|CDCA5|CHEK1|MIS18A|SKP2|DDX10|FEN1|PBK|XRCC3|TFDP1|CHPT1|BCL2|TMEM120B|EPS15L1|PTTG1|LIG1|SNRNP25|STMN1|SUV39H2|CDCA7L|CEP55|SLC2A1|MYBL2|CEP78|RAD18|TCF19|FANCA|DSN1|TMED8|SKA3|EBP|TST|DHRS2|TROAP|HAUS8|STC1|TTF2|KNTC1|TACC3|LMNB1|HPRT1|PLK1|TET2|SPDL1|DLGAP5|EXOSC5|TFAP4|RAD54B|PPIF|IGFBP4|BRI3BP|MTHFD1|LRR1|GGH|CCDC34|RAD51|POLA2|MASTL|PDSS1|PRC1|NUP107|FOXM1|SIAH2|DEPTOR|SLC7A5|CDT1|CCNA2|STIL|SLC9A3R1|ARL3|CHTF18|RAD54L|FKBP4|FAM83D|EXOSC2|NUSAP1|TONSL|UBE2T|IQGAP3|SMC2|GTSE1|RNASEH2A|PRR11|RAPGEFL1|TMEM38B|ZNF367|DNA2|INCENP|PRIM1|CENPN|ELOVL2|LSM4|ESPL1|KIF2C|NCAPD3|MANEAL|CHAF1B|ASPM|FAM111B|HAUS4|IL1RAP|CCNB2|PKIB|KIF11|NCAPG|GINS2|L2HGDH|MCM10|DCLRE1B|BUB1B|EXO1|CENPM|DTL|GINS1|CCNE2|CELSR2|NCAPH2|DARS2|SPC24|CTSD|CDK2|NME1|ASF1B|MGP|POLA1|MKI67|RRM1|FBXO5|WDR62|RFC3|ZWINT|CLSPN|AURKB|ARHGAP11A|FANCG|CHAF1A|KIF4A|CDC6|CDK1|RRM2|BRCA1|CENPL|RBBP8|UNG|BLM|WDR76|E2F1|E2F7|WDHD1|GMNN|DUT|E2F8|MCM5|AURKA|TYMS|PKMYT1|FANCC|MCM2|WDR34|MCM3|TPX2|LRIG1|VRK1|MCM4|UHRF1|RFC5|ATAD5|GINS3|TIMELESS|PAQR4|KIFC1|NASP|UBE2C|RFC2|SLC39A8|TRIP13|POLE2|SLC29A1|FREM2|SUV39H1|ATAD2|PCNA|DNMT1|ANLN|RBL1|POLD3|POLD1|TMPO|MCM8|KIF23|SHCBP1|MCM7|NUP85|NCAPD2|MCM6|MPHOSPH9|FKBP5|ZWILCH|PSMC3IP|RFC4|RMI1|FANCI|NCAPH|CDCA7|MMS22L|CDCA2|FANCD2|BIRC5|CDC45|TICRR|GAS2L3|TOP2A|CENPJ|CIT|BARD1|CENPI|TRAIP|TTK|NR2C2AP|SPAG5|CA12|DHTKD1|BRIP1|JAK2|MYO19|IMPA2|NOS1AP|ESCO2|BRCA2|RACGAP1|RPA3|FIGNL1|CBX5|BUB1|TMEM164|SLC39A6|HELLS|POLD2|POLE|MELK|DSCC1|NCAPG2|TK1|ABHD2|CEP85*	249	2.0332	0.0206
REACTOME_RESOLUTION_OF_AP_SITES_VIA_THE_MULTIPLE_NUCLEOTIDE_PATCH_REPLACEMENT_PATHWAY	*RFC1|PCNA|POLD3|POLD1|ADPRHL2|RPA1|PARP2|RFC3|APEX1|PARP1|POLB|LIG1|POLD2|POLE|RFC5|FEN1|POLE3|RPA2|RFC2|POLE4|POLE2|RPA3|RFC4*	23	2.0232	0.0233
REACTOME_RESOLUTION_OF_ABASIC_SITES_AP_SITES	*MUTYH|RPA1|APEX1|PARP1|XRCC1|MPG|RFC5|MBD4|TDG|FEN1|RPA2|NTHL1|RFC2|POLE4|POLE2|RPA3|RFC1|PCNA|LIG3|POLD3|POLD1|ADPRHL2|PARP2|RFC3|POLB|LIG1|POLD2|POLE|POLE3|PNKP|OGG1|UNG|NEIL2|RFC4|SMUG1*	35	2.0225	0.023

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
GO_ RIBONUCLEOPROTEIN _COMPLEX_ BIOGENESIS	*GLUL|NUFIP1|ABCE1|RPL14|GNL3L|RPS16|ZRSR2|URB1|RIOK3|POP7|SNUPN|HEATR3|EXOSC8|DDX10|DDX3X| RRP1|LUC7L3|AATF|FAM207A|URB2|MRPL22|YBEY|MRPS7|NLE1|RPP38|RPS9|DDX28|SNRPD1|ZNHIT3|PRPF6| RPL7L1|XRN2|PTEN|PWP1|RPS2|CUL4A|ERI1|RPL35|NOC4L|EIF3A|DDX21|EIF2A|HSP90AB1|NOL9|SNRPD3| MRPL11|TSR2|PELP1|SRFBP1|NSUN3|NGDN|WDR43|WDR12|EIF2S3|BYSL|RRP9|RAN|RPL10|EXOSC7|FTSJ3|SBDS |NOL11|RPL7|RPL12|LYAR|KRI1|GEMIN7|RPS28|RPS6|RPS7|RPS27|CELF1|SRSF6|SFSWAP|UTP14A|CPSF6|ESF1| CHD7|SRSF1|SART1|CELF2|DROSHA|RPP25|TGS1|NOP56|PRPF8|RPF1|NUDT16|ISG20L2|EXOSC3|NOL3|EXOSC5 |DDX52|EIF6|RPL24|SRPK1|RRNAD1|XAB2|SRSF12|USP4|RRN3|RPS10|RRP36|PRPF39|BRIX1|RBMX|SART3|RPS5| TEX10|EIF3B|NUP88|CLP1|NOL6|CD2BP2|RRS1|TRMT61B|NSUN4|PES1|ATM|LUC7L|RPL27|GEMIN6|PRPF3|RPL26| TARBP2|PRPF19|SDAD1|WBP11|EIF3D|RCL1|FCF1|EXOSC6|WDR77|EXOSC4|ERI3|RPUSD1|EXOSC1|GNL2|PSIP1| NPM1|EXOSC2|EXOSC10|NVL|RPF2|ZNF658|NOC2L|DDX39B|EIF4A3|DDX49|EXOSC9|DDX47|RPL6|EIF2D|RPL3| POP4|TFB1M|RPL35A|NMD3|STRAP|DIMT1|SRSF5|FBL|RPL13A|GCFC2|RBFA|RRP7A|LSM4|AAR2|DDX27|WDR75 |UTP6|RPLP0|RPS8|PA2G4|ZCCHC4|TAF9|MRPL20|NOP2|RRP15|TSR1|POP5|RPP40|ABT1|XPO1|ZNHIT6|SNRPD2| SNRPC|DDX51|MPV17L2|RIOK2|METTL16|SCAF11|GEMIN2|NOP16|RIOK1|HSP90AA1|SENP3|RUVBL1|RPL10A| ADAR|FRG1|THUMPD1|C1D|GTF3A|TSC1|CUL4B|SRPK2|DHX37|RPL7A|ATR|GTPBP10|LAS1L|SRSF9|SF3A3|SF3B1| UTP3|NOP14|NOL10|PIH1D1|SF3A2|TXNL4A|SNRNP200|NAF1|EIF3I|LTV1|RSL1D1|PTBP2|SF3A1|METTL15| GEMIN8|NCBP1|SF1|RPL11|EIF3H|DHX9|DKC1|EIF3M|WDR55|SNRPG|ERCC2|MCTS1|MDN1|MPHOSPH6|YTHDC1|E IF3F|WDR36|REXO4|PTGES3|DDX1|RPUSD2|SUV39H1|NOLC1|GAR1|ERAL1|DDX20|RPSA|COIL|DDX54|SETX| MPHOSPH10|NHP2|MRPS2|EIF3G|RRP1B|RPS15|SURF6|NSUN5|DDX56|RPL26L1|RPS21|NOB1|MRTO4|MRPL1| DENR|RPS19|MRM1|EIF3C|RPS27L|EIF5|MRPS11|USP39|LSM6|LUC7L2|RBM5|FBLL1|PRPF31|PAK1IP1|POLR2D| MALSU1|CPSF7|WDR18|DIS3|TBL3|EIF2S2|GEMIN5|RPL3L|PRMT5|EBNA1BP2|EIF3J|GTPBP4|TFB2M|RSL24D1| WDR74|EIF3E|ZNF593|BMS1|KRR1|SNRPF|ISG20|SNRPE|SHQ1|NSA2|DICER1|PRPF18|WDR46|DHX30|PDCD11| UTP23|SLU7|RPS24|EIF3K|DDX31|CEBPZ|TRMT112|IMP4|NPM3|NAT10|HELQ|PRMT7|NIP7|MRPL10|SNRPB| FASTKD2|MYBBP1A|CRNKL1|CLNS1A|DDX18|TSR3|EIF3L|NOL8|UTP20|BOP1|RRP8|NUDT21|RPL5|RPS14|UTP15 |GEMIN4|RPP30|ZNF622|HEATR1|EMG1|IMP3|NOP58|BTRC|UTP18|DCAF13|WDR3|NOP10|RPL23A|DDX17| C1QBP|RUVBL2|NOM1|RPL38|DDX23|CDC73*	367	2.0187	0.0234
GO_REGULATION_ OF_HISTONE_ METHYLATION	*NSD1|RTF1|KDM4D|ZNF335|MTF2|SNW1|MLLT6|PHF1|DNMT3B|PAF1|BCOR|CHTOP|KDM3A|PYGO2|LMNA| DNMT1|RIF1|SUPT6H|CTCF|ZNF274|WDR61|PRMT6|OGT|MECP2|PAXIP1|SIRT1|KPNA7|CTNNB1|EED|MTHFR| KDM1A|PHF19|SMARCB1|AUTS2|SMAD4|PIH1D1|BRCA1|KDM4C|BRD4|CTR9|RNF20|SETD7|ATRX|IWS1*	44	2.0129	0.0249
TANG_SENESCENCE_ TP53_TARGETS_DN	*NEK2|CENPE|SMC4|PRC1|FOSL2|ADARB1|TPX2|TFAM|RACGAP1|CCNA2|NUP62|PBK|UBE2C|KIF20A|BIRC5|CDC20| CTH|TCF4|PPL|FBXO5|NRGN|BUB1|MAF|TOP2A|KIF23|NUSAP1|PTTG1|LMNB1|EZH2|AURKB|IGFBP5|CCNB2| KIF20B|KIF4A|EXOSC9|DBF4|MAP1B|KIF11|BARD1|CDK1|TTK|SPAG5|PDP1|TK1*	44	2.0116	0.0246
GO_REGULATION_ OF_CHROMOSOME_ SEGREGATION	*BUB1B|NEK2|ANAPC1|HNRNPU|RIOK2|TNKS|CDC42|CDCA5|TTL|CDT1|TEX14|FEN1|ATM|XRCC3|NEK6|MAD1L1| CDC23|MAD2L2|CUL3|CDC20|MKI67|CTCF|ZW10|FBXO5|LCMT1|NUMA1|PTTG1|AURKB|CTNNB1|SMC5|PUM2| NIPBL|CDC6|RB1|TTK|SPAG5|DDX11|ANAPC5|PUM1|ATRX|NAA10|MAD2L1|CENPE|RAD18|ZNF207|PCID2| ANAPC4|CENPF|RACGAP1|HDAC8|KLHL22|CDC27|RAD21|KIF2C|ESPL1|SMC6|CDC26|TRIP13|TPR|SIRT2|RMI2| BUB1|BUB3|GEN1|CCNB1|DYNC1H1|TACC3|CSNK2A2|SFPQ|CSNK2A1|PLK1|ANAPC11|SPDL1|PSMG2|ECT2| DLGAP5|RCC2|DYNC1LI1|CDK5RAP2|APC|HECW2|BECN1|IK|NSMCE2|NDC80*	85	2.0115	0.024

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
GO_POSITIVE_REGULATION_OF_CHROMATIN_ORGANIZATION	*SIN3A|MTF2|SNAI2|DNMT3B|PPHLN1|SART3|PRKD1|MAPK3|ATM|ARRB1|C6ORF89|MPHOSPH8|FMR1|MORC2|BRD7|GLYR1|WDR61|AKAP8|MECP2|PAXIP1|SIRT1|ING2|RPS6KA4|CTNNB1|NIPBL|SMAD4|ZBTB7B|PIH1D1|AUTS2|CTBP1|BRCA1|CTR9|SPHK2|RTF1|TADA2A|SNW1|PHF1|KAT7|PAF1|TP53|JDP2|ATF7IP|RNF40|CHTOP|PRKD2|LRRK2|TPR|LMNA|PIWIL2|SETDB1|DNMT1|RIF1|TADA2B|WBP2|SREBF1|MIER1|OGT|AKAP8L|CCNB1|KAT2A|KPNA7|TRIM28|RPS6KA5|EED|UBE2N|KDM1A|PHF19|SIRT6|SMARCB1|CDK9|RUVBL2|BRD4|RNF20*	73	2.0111	0.0236
FURUKAWA_DUSP6_TARGETS_PCI35_DN	*DTL|PDSS1|PRC1|CCNE2|RIOK1|CCNA2|WDR5|PRMT5|EBNA1BP2|PBK|ORC6|STIL|RRM1|PMEPA1|TUSC1|NUSAP1|EPHA2|AURKB|ARHGAP11A|KIF20B|CEP55|TCHP|BLM|SYNE3|MCM5|AURKA|PDLIM2|RTEL1|PRIM1|KHDRBS3|CENPF|TPX2|RACGAP1|MCM4|ETS1|HPCAL1|KIF2C|CTNNAL1|IVD|LAMB3|NEDD4L|SHCBP1|SIPA1L3|CCNB1|NCAPD2|CCNB2|WDR3|KIF11|DLGAP5|NCAPG|MAFF|CKAP2|HJURP|RFC4*	54	2.0008	0.0267
GO_SISTER_CHROMATID_SEGREGATION	*BUB1B|NEK2|CHMP1A|PHF23|ANAPC1|TTN|RIOK2|NCAPH2|TNKS|CDCA5|TEX14|FEN1|TUBG1|DDX12P|XRCC3|NEK6|HIRA|MAD1L1|CDC23|MAD2L2|CUL3|CDC20|CTCF|FBXO5|BOD1|AKAP8|NAA50|ZWINT|PTTG1|AURKB|DIS3L2|SMC5|KIF4A|NIPBL|CDC6|MSTO1|MCMBP|ATRX|VPS4B|NAA10|MAD2L1|KIF22|CENPE|RAN|SMC4|DSN1|CHMP4A|PDS5A|CHMP6|SMC1A|SEH1L|SMC3|NUF2|ANAPC4|RAD21|KIFC1|KPNB1|NSL1|CDC26|TRIP13|TPR|CENPK|KATNB1|RMI2|PINX1|KIF23|BUB3|AKAP8L|CCNB1|CHMP4B|TACC3|SFPQ|PLK1|ANAPC11|NCAPD2|SPDL1|PPP2R1A|PSMG2|RAB11A|DLGAP5|DYNC1LI1|CDK5RAP2|HECW2|NSMCE2|NCAPH|HNRNPU|CHMP7|KIF18A|PRC1|INO80|PHF13|CDT1|PIBF1|RRS1|ATM|STAG3|CHMP2B|CHMP1B|ZW10|LCMT1|KIF4B|NUMA1|TOP2A|NUSAP1|CTNNB1|SMC1B|RB1|TTK|SMC2|SPAG5|DDX11|ANAPC5|KIF14|PDS5B|LATS1|INCENP|CHTF8|ZNF207|ESCO2|PCID2|CENPF|MAU2|RACGAP1|HDAC8|MIS12|KLHL22|CDC27|KIF2C|NCAPD3|NUP62|ESPL1|CDCA8|VPS4A|STAG2|STAG1|PHB2|BUB1|TOP2B|GEN1|POGZ|CHAMP1|RAD51C|ESCO1|CHMP5|PSRC1|KIF18B|NCAPG|APC|CHMP2A|DSCC1|BECN1|IK|NDC80*	153	1.995	0.0282
ZHOU_CELL_CYCLE_GENES_IN_IR_RESPONSE_24HR	*NEK2|EXO1|NCAPH2|LAMB1|EXOSC8|HMMR|CDK2|TDP1|TPRKB|SPC25|HMGB3|CDC20|POC1A|FBXO5|KPNA2|PTTG1|IFT20|EZH2|CDK1|CSE1L|CEP55|RBBP8|DCN|FGFR1OP|MYBL2|E2F1|MAD2L1|KIF22|E2F8|TOPBP1|NUF2|CHAC2|MCM2|HAUS3|MCM3|DNAJC9|FBLN1|UHRF1|RFC5|GINS3|TIMELESS|RANBP1|HAUS8|KIFC1|NASP|UBE2C|TRIP13|KIF20A|CACYBP|PCNA|DCTPP1|ANLN|POLD1|CENPK|WIPI1|HMGB2|MCM8|KIF23|MCM7|CCNB1|LMNB1|KNTC1|ODF2|DLGAP5|RFC4|ALYREF|EIF2S1|GPN3|PRC1|NUP107|NUP88|MDC1|CCNA2|CLN6|USP1|QSER1|BIRC5|RAD54L|NEIL3|TOP2A|NUSAP1|UBE2T|TTK|SPAG5|SMC2|FABP5|LBR|CMC2|CENPN|CENPF|RACGAP1|RPA2|CDCA8|ASPM|PAICS|BUB1|CCNB2|KIF11|CDKN3|CKAP2|MELK|DTYMK|SMPD4*	103	1.9876	0.0299
NAKAYAMA_SOFT_TISSUE_TUMORS_PCA2_UP	*ENO2|NEK2|NCAPH|TPBG|SCG5|NCAM1|SLC7A5|FOXF2|HMMR|CCNA2|PITX1|PLP2|PBK|PSD3|NRP2|FBN2|BIRC5|APLP1|CDC20|MKI67|TOP2A|NUSAP1|SHOX2|TRPS1|MLLT11|CDK1|CEP55|RRM2|GTSE1|CENPE|UBE2S|CENPN|CENPF|TPX2|MCM4|SSX3|CKS2|COL9A3|ESPL1|KIF2C|SLC16A3|LEF1|AHNAK2|UBE2C|CDCA8|KIF20A|MICAL2|ASPM|FZD1|SV2A|GPSM2|BUB1|CCNB1|CDH11|TBL1X|CCNB2|KIF11|CDKN3|DLGAP5|TNC|EFNA3|MELK|HJURP*	63	1.9875	0.0293
GO_HISTONE_METHYLATION	*CARM1|PRDM2|ZNF335|MTF2|DNMT3B|FBLL1|RBBP5|WDR5|PRMT5|EHMT2|WDR82|SETD5|SMYD3|SETMAR|EHMT1|MEN1|CTCF|PWP1|COPRS|ZNF274|WDR61|PRMT6|MECP2|PAXIP1|SIRT1|EZH2|CTNNB1|SUV39H2|MTHFR|EZH1|TTLL12|SETD6|ASH2L|SMAD4|PIH1D1|AUTS2|BRCA1|SETD3|CTR9|SETD2|SETD7|ATRX|IWS1|NSD1|PRMT7|RTF1|KDM4D|BEND3|FBL|MLLT6|SNW1|PHF1|KDM6A|PAF1|BCOR|SUZ12|CXXC1|ARID4B|PRMT2|ARID4A|CHTOP|PAGR1|RLF|KDM3A|PRMT1|SUV39H1|PYGO2|LMNA|SETDB1|DNMT1|SETD1B|RIF1|SUPT6H|OGT|MECOM|KPNA7|TET2|EED|SETD1A|NTMT1|DOT1L|KDM1A|PHF19|SMYD2|SMARCB1|ASH1L|KDM4C|BRD4|RNF20*	89	1.9859	0.0295

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
GO_PROTEIN_CONTAINING_COMPLEX_DISASSEMBLY	*SWAP70|NCKAP5L|MRPS15|MRPL34|CHMP1A|ABCE1|OGFOD1|UPF1|APEH|GSK3B|AURKAIP1|SEMA5A|LIMA1|MRPL55|MRPL22|MRPL27|SMARCD2|MRPS7|UBQLN4|PPP1R9B|TSG101|KIF5B|PEX14|STMN1|MRRF|VPS33A|BNIP3|MRPL11|MRPS9|EIF5A|ATG14|GBA|SET|SCAF4|MRPL32|MRPS26|MCOLN1|MICAL1|FZD2|IGF1R|MRPL17|TMOD1|MAP1LC3B|ZMPSTE24|MRPL2|MRPL4|DAP3|MRPL38|MID1|SMARCD3|MRPL24|MRPS31|PDXP|EPG5|MID1IP1|CLEC16A|MRPS23|SUPT16H|TFIP11|WNT8B|MICAL2|GFM2|MRPL47|ETF1|HMGA1|STMN3|CFL2|PTCD3|KLC1|SPTBN2|ARHGEF2|CIB1|MRPS18B|SMARCB1|MRPL52|INSR|GADD45GIP1|MRPS10|MRPL30|MRPS28|MRPL18|RPL23|CHMP7|KIF18A|MRPS6|DHX8|CCSAP|TMOD2|SCAF8|DSTN|CAMSAP1|CHCHD10|CTNNB1|MRPL45|MAP1LC3A|NES|CAPG|MICAL3|GSPT1|SNAPIN|EPS8|SMCR8|MTRF1L|MRPL50|SPAST|KIF2C|MRPL49|HSPA8|EIF5A2|SMARCE1|MRPL42|ADD1|CLASP1|MRPL20|CFL1|TECPR1|MRPL28|CHMP5|GRWD1|KIF18B|APC2|CKAP2|APC|ADD3|MRPL19|MRPL12|GSPT2|FYCO1|PHF23|MRPS5|MRPL44|NSF|MRPL9|GABARAP|MRPS34|WDR1|GAK|MRPL14|MRPL40|CAPZB|MRPS25|MRPS35|MRPL53|MRPS36|MTRF1|MRPL16|MRPL43|MRPL39|OXA1L|MRPS16|DDIT4|SPTBN1|KIF24|MRPS14|MRPL46|VPS4B|MRPS27|MRPS12|SMARCD1|PPP1CA|NAPA|SH3GL1|GSN|IST1|TBC1D25|HDAC6|N6AMT1|MRPL51|MRPL23|MRPS21|MRPL54|PBRM1|RDX|MAP1S|MRPL33|PLEKHH2|CAMSAP2|VCP|ERAL1|KATNB1|MRPL13|TWF2|TWF1|GLE1|SETX|CSNK1A1|MRPS2|MRPS17|MRPS24|VTA1|MAP1B|MRPL1|SYNJ1|MRPL37|CHCHD1|MRPL41|UVRAG|CAPZA1|CLASP2|MRPS11|CAPZA2|ACTN2|LRP6|ARID2|ASPH|STX17|MRPL3|MRPS33|MRPL15|ARID1A|MRPS18C|CHMP2B|MAP1A|CHMP1B|SH3BP1|MRPS18A|SNAP29|SMARCC1|SPTAN1|MRPL48|NAPB|TRIOBP|ZFAND1|C12ORF65|UBQLN1|CKAP5|MRPL21|SMARCA4|MRPS30|KIF2A|TRMT112|GABARAPL1|LAMP2|TMOD3|SPTA1|MRPL35|TAOK1|AXIN1|MRPL10|DVL2|MRPS22|CAV1|VPS16|CLN3|SNX14|DVL3|GABARAPL2|VPS4A|FZD1|SMARCC2|DVL1|CHMP2A|CALCOCO2*	253	1.9848	0.0294
KEGG_VALINE_LEUCINE_AND_ISOLEUCINE_DEGRADATION	*EHHADH|ACADS|DBT|AOX1|ACAT2|MCEE|ACAA1|ACAD8|HIBCH|MCCC2|MCCC1|HMGCL|PCCA|HMGCS1|AUH|IVD|ECHS1|DLD|BCKDHB|BCAT2|ALDH6A1|HADHA|HADHB|HSD17B10|HADH|ALDH7A1|ACADM|OXCT1|PCCB|HIBADH|ALDH1B1|ALDH9A1|ALDH2|ACAT1|ALDH3A2|ACAA2|BCAT1|BCKDHA|ACADSB|ABAT*	40	1.982	0.0299
HOFFMANN_LARGE_TO_SMALL_PRE_BII_LYMPHOCYTE_UP	*NEK2|NCAPH2|CRIP2|CDCA5|FEN1|NEDD4|MIS18BP1|DDX19A|HMGB3|POLA1|CDC20|FAM111A|RRM1|MKI67|KPNA2|RFC3|KIN|LIG1|STMN1|AURKB|DBF4|KIF4A|CDK1|MMP14|PIH1D1|RRM2|CENPL|HTT|TUBB|GPHN|KIF22|WDHD1|CENPE|PPP1CA|AURKA|SMC4|E2F8|RPA1|GSN|PSMC3|RFC5|NUCKS1|KIFC1|NASP|ARL1|UBE2C|IDE|TRIP13|SLC29A1|EIF2AK2|KIF20A|DNMT1|ANLN|DCTPP1|RBL1|COIL|HMGB2|TMPO|KIF23|CCNB1|MYH11|ANP32A|SPDL1|MCM6|DLGAP5|NT5DC2|SSX2IP|RAMP1|NCAPH|RAD51|VPS72|PRC1|CDC25C|LDHA|CDCA3|CBX1|CKS1B|TUBB4B|CCNA2|CTC1|PPP2CA|TUBB3|RAD54L|CDC45|TOP2A|NUSAP1|ZNF358|ANP32B|STIM1|UBE2T|ANP32E|CIT|CKAP5|TTK|SMC2|CDKN1A|HES1|MYEF2|UBE2S|INCENP|GSPT1|DNA2|CASP3|FLII|BRCA2|RACGAP1|NUDC|CKS2|KIF2C|PCK2|CHAF1B|CBX5|IPO5|ENO1|TRIM46|ABR|BUB1|HAUS6|HELLS|ACY1|CCNB2|ECT2|XPO1|CDKN3|MELK|SNX2|HJURP|ACTN4|TUBA1A|MCM10|MTHFD2|TK1|NDC80*	133	1.9812	0.0296
YUAN_ZNF143_PARTNERS	*PNN|DIDO1|RBM33|LMO7|SNW1|NUSAP1|INO80|CHD8|RRP1B|TPX2|DCAF13|YY1|GPBP1|HCFC1|RUVBL1|BRD2|JRK|GTPBP4|RAVER1|SAP18*	20	1.9763	0.031
CROONQUIST_IL6_DEPRIVATION_DN	*BUB1B|WEE1|NCAPH|GINS1|CCNE2|FOXM1|GALK1|CHEK1|SKP2|CKS1B|HMMR|AASS|CCNA2|ABHD5|SPC25|STIL|PTPRC|CDC20|MKI67|CDC45|OIP5|KPNA2|TOP2A|RFC3|PTTG1|ZWINT|STMN1|LIG1|AURKB|SEPHS1|CHAF1A|CDC6|GMPS|ANP32E|CDK1|TRAIP|RRM2|SMC2|BRCA1|SPAG5|CCNF|SBNO2|SNRPA1|MYBL2|APOBEC3B|MAD2L1|KIF14|KIF22|DUT|CENPE|AURKA|SMC4|TYMS|MCM2|TPX2|MCM3|MCM4|GALE|CKS2|KIF2C|NASP|KIFC1|UBE2C|TRIP13|POLE2|SPP1|PCNA|RRP12|HMGA1|POLD1|HMGB2|BUB1|GPX4|MCM7|CCNB1|KNTC1|PLK1|CCNB2|KIF11|CDKN3|DTYMK|TK1|GGH|FANCI*	84	1.975	0.0307

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
REACTOME_LAGGING_STRAND_SYNTHESIS	*RFC1|POLA1|PCNA|POLD3|POLD1|PRIM2|POLA2|DNA2|RPA1|RFC3|LIG1|PRIM1|POLD2|RFC5|FEN1|RPA2|RFC2|RPA3|RFC4*	19	1.9699	0.0321
YU_MYC_TARGETS_UP	*FDPS|GMNN|DTL|E2F8|AURKA|UBE2S|IDI1|BRCA2|NUDCD2|RACGAP1|CKS1B|CLIC4|NUP54|CKS2|FAM136A|TFDP1|TXN|KIF20A|BIRC5|ASPM|PCNA|ANLN|DCTPP1|MKI67|RRM1|HMGB2|BUB1|KPNA2|TOP2A|HMGN2|CCNB1|UCHL5|PLK1|CCNB2|ECT2|CDKN3|CDK1|STRAP|TSPAN4*	39	1.9683	0.0321
REACTOME_POLYMERASE_SWITCHING_ON_THE_C_STRAND_OF_THE_TELOMERE	*RFC1|POLA1|CHTF18|PCNA|POLD3|POLD1|PRIM2|POLA2|RFC3|CHTF8|PRIM1|POLD2|RFC5|RFC2|DSCC1|RFC4*	16	1.9655	0.0329
MARTIN_NFKB_TARGETS_UP	*GTF3C1|BCL2|PPP1R1B|TRIM2|OSMR|MTRF1|CASP4|FSD1|TTYH3|PRKCE|DUSP6|IGFBP7|LATS2|SPP1|SLC29A1*	15	1.9648	0.0326
GO_PEPTIDYL_LYSINE_METHYLATION	*PRDM2|ZNF335|MTF2|DNMT3B|RBBP5|WDR5|EHMT2|WDR82|SETD5|SMYD3|SETMAR|EHMT1|MEN1|PWP1|ZNF274|WDR61|PRMT6|MECP2|PAXIP1|SIRT1|EZH2|CTNNB1|SUV39H2|EZH1|TTLL12|SETD6|ASH2L|SMAD4|PIH1D1|AUTS2|BRCA1|SETD3|CTR9|SETD2|SETD7|ATRX|IWS1|NSD1|RTF1|KDM4D|BEND3|MLLT6|SNW1|PHF1|KDM6A|BCOR|SUZ12|CXXC1|ARID4B|ARID4A|PAGR1|RLF|KDM3A|SUV39H1|PYGO2|LMNA|SETDB1|DNMT1|SETD1B|RIF1|SUPT6H|OGT|METTL21A|CAMKMT|MECOM|KPNA7|TET2|EED|SETD1A|DOT1L|KDM1A|PHF19|SMYD2|SMARCB1|ASH1L|KDM4C|BRD4*	77	1.9641	0.0324
KONG_E2F3_TARGETS	*BUB1B|RPRD1B|NCAPH|RAD51|PRC1|MAPK8|CDCA3|CDCA5|RAD51AP1|NUP50|SKP2|HMMR|CCNA2|FEN1|SPC25|PBK|CDC7|ASF1B|USP1|CDC20|FAM111A|RAD54L|MKI67|PSIP1|CENPQ|TOP2A|NUSAP1|EZH2|UBE2T|CDC6|IQGAP3|RPL3|BRCA1|SMC2|RBBP8|CCNF|MED1|NR1D1|AURKA|TYMS|DNA2|INCENP|E2F3|NUF2|RPL12|PRIM1|MCM3|TPX2|CENPF|RACGAP1|CENPH|KIF2C|FBXO45|CBX2|NASP|UBE2C|CHAF1B|KIF20A|RBL1|CENPK|FIGNL1|HMGB2|BUB1|SHCBP1|CCNB1|LMNB1|TACC3|PLK1|NCAPD2|SPDL1|KIF11|DLGAP5|DCK|NCAPG|SRSF7|MELK|HJURP|ERCC6L|NCAPG2|TK1*	80	1.9631	0.0323
GO_MATURATION_OF_5_8S_RRNA	*EXOSC7|URB1|FTSJ3|EXOSC8|MPHOSPH6|KRI1|RRS1|PES1|BOP1|UTP20|RCL1|C1D|EXOSC4|ERI3|ERI1|EXOSC2|EXOSC10|LAS1L|NOL9|EXOSC9|RPS21|NOP14|ABT1|EXOSC3|WDR12*	25	1.9621	0.0321
GO_REGULATION_OF_PROTEIN_DEPOLYMERIZATION	*SWAP70|CAPZA1|CLASP2|CAPZA2|SEMA5A|ACTN2|WDR1|LIMA1|ASPH|TMOD2|CAPZB|DSTN|MAP1A|CAMSAP1|SH3BP1|SPTAN1|TRIOBP|SPTBN1|NES|CAPG|TMOD3|TMOD1|SPTA1|GSN|TAOK1|HDAC6|MID1|EPS8|PDXP|SPAST|MID1IP1|RDX|MAP1S|PLEKHH2|CAMSAP2|ADD1|KATNB1|CLASP1|TWF2|TWF1|CFL2|CFL1|SPTBN2|ARHGEF2|CIB1|MAP1B|APC2|CKAP2|APC|ADD3*	50	1.9591	0.0328
LEE_EARLY_T_LYMPHOCYTE_UP	*BUB1B|NEK2|CD99|DTL|CDCA2|NLGN4X|GINS1|PRC1|CDCA3|RAD51AP1|HMMR|TUBB4B|RUFY3|PBK|HMGB3|BIRC5|SLC1A4|NEIL3|MKI67|OIP5|TOP2A|NUSAP1|PTTG1|KIF15|UBE2T|CPVL|CXXC5|LETM1|CDK1|CEP55|TTK|RRM2|ADA|HHIP|E2F7|PRR11|TUBB|KIF14|FAIM|E2F8|AURKA|TYMS|DIAPH3|GALNT7|GSE1|NUF2|MCM2|MCM4|UHRF1|CKS2|KIF2C|MPP1|UBE2C|CEP128|AEBP1|KIF20A|ASPM|ATAD2|BUB1|PALLD|SCRN1|CCNB1|RCAN1|TNFRSF21|CCNB2|KIF11|CENPW|KIF18B|DLGAP5|NCAPG|CDKN3|MELK|MCM10|DSCC1|LRR1|GGH|FANCI|NDC80*	78	1.9566	0.0333
GO_NEGATIVE_REGULATION_OF_ACTIN_FILAMENT_POLYMERIZATION	*BBS4|TMOD3|TMOD1|CAPZA1|SPTA1|CAPZA2|ARFGEF1|GSN|PFN2|PRKCD|EPS8|TMOD2|TMSB4X|PFN1|RDX|CAPZB|MYADM|ADD1|TWF2|TWF1|SPTAN1|TRIOBP|SPTBN2|KANK1|TMSB10|HIP1R|SPTBN1|CAPG|ADD3*	29	1.9539	0.0338

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
MANALO_HYPOXIA_DN	*TOE1|SLC1A5|AIMP2|URB1|POP7|HEATR3|AASDHPPT|EXOSC8|SKP2|WDR4|NARS2|RRP1|URB2|FEN1|SLC19A1|TUBG1|PBK|COQ2|NLE1|ORC6|PSMG1|SNRPD1|ID1|TELO2|SCLY|RBM28|CLPB|DDX21|CISD1|SLC11A2|NCS1|LETM1|SLC25A15|CCNF|WDR12|UMPS|NUP98|MAD2L1|GNPDA1|RRP9|BYSL|METTL2B|ATIC|SEH1L|NOL11|SEC23IP|MNS1|RANBP1|UTP14A|C20ORF27|MAP2K3|SRSF2|HMGA1|NOP56|SAR1B|UBIAD1|NDUFAF4|SPDL1|PPAT|GCSH|PPIF|ABCF2|MTHFD1|RAD51|POLA2|EIF2S1|PDSS1|PRC1|TIPIN|CCNA2|RRS1|CDC7|GEMIN6|STIL|CUTC|NCLN|PHB|WDR77|OIP5|EXOSC2|NVL|NUSAP1|PRPS1|GART|GLRX2|ATP13A3|DNA2|UBE2S|PFAS|CENPN|TSEN2|NCAPD3|PA2G4|PPARD|ELK1|POMT2|DHCR24|TSR1|RRP15|UCHL5|POP5|RPP40|GRWD1|AKAP1|GINS2|HJURP|MCM10|TOP3A|ELOVL6|POLR3G|EXO1|GINS1|CCNE2|RAD51AP1|GEMIN2|NOP16|PSME4|NEK4|SLC25A10|RUVBL1|NME1|MRPL40|FAM136A|DDX19A|ASF1B|SRRT|MFN2|RRM1|TOR3A|FBXO5|IDH3A|ARMC6|RFC3|ZWINT|CTPS1|VWA8|FASN|NUP43|GK|LMNB2|FANCG|DBF4|CHAF1A|CDC6|IPO4|CDK1|CSE1L|SNAPC5|RRM2|BRCA1|SNRPA1|PCYT2|MRPL46|FUS|HNRNPD|MRPS12|GMNN|ILF3|NUP188|DKC1|MCM5|PARP1|PKMYT1|EIF2B3|MCM2|TPX2|MCM3|DNAJC9|MCM4|VRK1|RFC5|GINS3|CBWD1|NASP|RFC2|NIF3L1|DLAT|IDE|FXN|POLE2|TRIP13|PAIP1|NOLC1|GPD1L|NUP205|KIF23|SHCBP1|NUP85|PARP2|RRP1B|CD3EAP|MCM6|MPHOSPH9|CIAO1|MRTO4|ZWILCH|PSMC3IP|FANCI|MAZ|HNRNPU|USP39|PAK1IP1|TFAM|TUBB4B|DHCR7|LRP8|NUP160|PRMT5|EBNA1BP2|SLC5A6|GTPBP4|C17ORF80|WDR74|USP1|SRM|FBXO42|PSMD11|PNO1|TSFM|NOL12|RB1|BARD1|POLR2L|DDX11|EEF1E1|NAT10|MLLT10|PRMT7|C1ORF112|PDCD2|ACAT2|AMDHD2|SACS|PUS1|DDX18|MCFD2|UTP20|BOP1|RPP30|HEATR1|EMG1|BCS1L|TUBGCP4|POLD2|CAD|POLR3K|HMBS|C1QBP|PSME3|MELK|ERCC6L|FERMT1|DDX23|RSAD1|DHX35*	255	1.9479	0.0359
GO_CLEAVAGE_INVOLVED_IN_RRNA_PROCESSING	*ERI3|ERI1|EXOSC2|EXOSC10|EXOSC7|NHP2|RRP36|EXOSC8|NOL9|KRI1|EXOSC9|RPS21|NOP14|RRS1|ABT1|EXOSC3|NOB1|UTP23|BOP1|UTP20|RCL1*	21	1.9472	0.0357
REACTOME_CHROMATIN_MODIFYING_ENZYMES	*TAF6L|KDM5B|ARID1B|CARM1|GATAD2B|PADI3|PRMT3|DMAP1|PHF2|MORF4L1|WDR5|HMG20B|RUVBL1|SMARCD2|EHMT2|ATF2|MORF4L2|MBIP|GATAD2A|KDM6B|RBBP4|ELP6|SAP130|SUDS3|KAT6B|KAT6A|REST|NFKB1|KANSL3|RELA|ACTL6B|RPS2|PADI2|PRMT6|HDAC2|EZH2|SUV39H2|KAT2B|NCOA2|RCOR1|ASH2L|ELP2|BRPF3|SETD7|SETD2|BRMS1|SUPT7L|NSD1|TADA1|SMARCD1|PHF21A|PHF8|BRD1|TAF12|TAF10|EP400|SMARCD3|HDAC10|HCFC1|SUZ12|USP22|BRD8|PBRM1|EP300|ENY2|ARID5B|CHD4|MBD3|JMJD6|PRMT1|SUV39H1|TADA2B|MTA3|KANSL1|SETD1B|ATXN7|NCOR2|BRWD1|MECOM|EED|CREBBP|DOT1L|SMYD2|ING5|SMARCB1|HDAC3|SAP18|PHF20|YEATS4|KDM5C|NFKB2|RBBP7|VPS72|MSL1|TADA3|MRGBP|RBBP5|KAT8|HAT1|ARID2|KDM5A|KAT5|PRMT5|ELP5|SMYD3|GPS2|MTA2|SUPT3H|ARID1A|CLOCK|KANSL2|EHMT1|NCOR1|TBL1XR1|WDR77|SMARCA2|ATXN7L3|COPRS|DNMT3A|SMARCC1|TAF5L|BRPF1|SETD6|TRRAP|MSL2|SMARCA4|SETD3|ACTB|ELP3|SAP30L|JAK2|PRMT7|KDM2B|TADA2A|ACTL6A|HDAC1|KDM4D|KDM6A|DR1|KAT7|CHD3|MEAF6|HDAC8|EPC1|AEBP2|ARID4B|ELP4|KDM2A|ARID4A|KDM5D|ATF7IP|KDM3A|NCOA1|KDM3B|ING4|TAF9|ING3|CDK4|SETDB1|SMARCE1|KDM1B|SAP30|YEATS2|OGT|MCRS1|KAT2A|MTA1|TBL1X|SMARCC2|SETD1A|KDM1A|MSL3|ASH1L|KDM4A|KDM4B|RUVBL2|KDM4C*	177	1.946	0.0357
GO_POSITIVE_REGULATION_BY_HOST_OF_VIRAL_TRANSCRIPTION	*CCNT1|GTF2B|CTDP1|CHD1|SNW1|RRP1B|TAF11|ZNF639|JUN|SMARCB1|SMARCA4|EP300|LEF1|NUCKS1|TFAP4|SP1*	16	1.9441	0.036

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
REACTOME_TRANSLESION_SYNTHESIS_BY_POLH	*RFC1|PCNA|UBA52|RPS27A|RPA1|RFC3|UBB|SPRTN|RFC5|RPA2|RCHY1|POLH|RFC2|RPA3|RFC4|VCP|NPLOC4*	17	1.9353	0.0386
GO_MYOFIBRIL_ASSEMBLY	*MEF2C|TMOD3|TMOD1|TTN|AKAP13|KRT8|ACTN2|PGM5|WDR1|MYH10|MYOM1|PDGFRB|CSRP1|TMOD2|CFLAR|NEBL|PRKAR1A|ACTG1|MEF2A|CFL2|PROX1|MYH11|ACTC1|OBSL1|ITGB1|ACTA1|SMAD4|PDGFRA|MYH6|TPM1*	30	1.9342	0.0386
BURTON_ADIPOGENESIS_PEAK_AT_24HR	*TRAPPC5|KIF22|S100A8|PRC1|CDC25C|GALK1|ELAVL1|RACGAP1|SNRNP70|HMMR|CCNA2|KIFC1|UBE2C|KIF20A|SRSF1|CDC20|ANLN|DCTPP1|RRM1|IPO5|BUB1|KPNA2|TOP2A|NUSAP1|PTTG1|CCNB1|STMN1|AURKB|CAD|ISYNA1|RANGAP1|EXOSC5|CDK1|MELK|AGT|CENPL|TK1*	37	1.9261	0.0421
FINETTI_BREAST_CANCER_KINOME_RED	*BUB1B|NEK2|MASTL|AURKA|BUB1|CHEK1|PLK1|AURKB|VRK1|CDK1|PBK|TTK|SRPK1|CDC7|MELK*	15	1.9257	0.0417
GO_PROTEIN_DEPOLYMERIZATION	*SWAP70|NCKAP5L|CAPZA1|CLASP2|KIF18A|CAPZA2|SEMA5A|ACTN2|WDR1|GAK|LIMA1|ASPH|CCSAP|TMOD2|CAPZB|DSTN|PPP1R9B|MAP1A|CAMSAP1|SH3BP1|SPTAN1|STMN1|TRIOBP|SPTBN1|CKAP5|KIF24|NES|CAPG|KIF2A|MICAL3|VPS4B|MICAL1|TMOD1|TMOD3|SPTA1|SH3GL1|GSN|TAOK1|HDAC6|MID1|EPS8|PDXP|SPAST|MID1IP1|KIF2C|RDX|HSPA8|MAP1S|PLEKHH2|VPS4A|CAMSAP2|MICAL2|ADD1|KATNB1|CLASP1|TWF2|STMN3|TWF1|CFL2|CFL1|SPTBN2|ARHGEF2|CIB1|MAP1B|KIF18B|APC2|CKAP2|SYNJ1|APC|ADD3*	70	1.9251	0.0414
GO_MITOTIC_SISTER_CHROMATID_SEGREGATION	*BUB1B|NEK2|CHMP1A|PHF23|ANAPC1|TTN|RIOK2|NCAPH2|TNKS|CDCA5|TEX14|TUBG1|XRCC3|NEK6|HIRA|MAD1L1|CDC23|MAD2L2|CUL3|CDC20|FBXO5|BOD1|AKAP8|NAA50|ZWINT|PTTG1|AURKB|DIS3L2|SMC5|KIF4A|NIPBL|CDC6|MSTO1|ATRX|VPS4B|NAA10|MAD2L1|KIF22|CENPE|RAN|SMC4|DSN1|CHMP4A|PDS5A|CHMP6|SMC1A|SEH1L|NUF2|ANAPC4|RAD21|KIFC1|KPNB1|NSL1|CDC26|TRIP13|TPR|CENPK|KATNB1|PINX1|KIF23|BUB3|AKAP8L|CCNB1|CHMP4B|TACC3|PLK1|ANAPC11|NCAPD2|SPDL1|PPP2R1A|PSMG2|RAB11A|DLGAP5|DYNC1LI1|CDK5RAP2|HECW2|NSMCE2|NCAPH|HNRNPU|CHMP7|KIF18A|PRC1|INO80|PHF13|CDT1|PIBF1|RRS1|ATM|CHMP2B|CHMP1B|ZW10|LCMT1|KIF4B|NUMA1|NUSAP1|RB1|TTK|SMC2|SPAG5|ANAPC5|KIF14|PDS5B|INCENP|CHTF8|ZNF207|PCID2|CENPF|MAU2|RACGAP1|MIS12|KLHL22|CDC27|KIF2C|NCAPD3|NUP62|ESPL1|CDCA8|VPS4A|BUB1|GEN1|POGZ|CHAMP1|CHMP5|PSRC1|KIF18B|NCAPG|APC|CHMP2A|DSCC1|BECN1|IK|NDC80*	132	1.9245	0.0411
MOLENAAR_TARGETS_OF_CCND1_AND_CDK4_DN	*E2F7|MTMR1|NCAPH|CDCA7|DTL|CDCA2|AURKA|ZNF367|PDLIM3|TPX2|CENPF|ELAVL1|RFC5|PTBP3|CENPH|SPC25|KIF2C|MNS1|ENDOD1|CDCA8|TRIP13|GPC6|KIF20A|FAM204A|POLD3|TOR3A|CENPK|FAM83D|CDC45|ERI1|GAS2L3|DONSON|MCM7|KIF20B|MED30|KIF4A|KIF11|CDCA7L|CDC6|CEP55|MELK|HJURP|PSMC3IP*	43	1.9243	0.0407
GO_MATURATION_OF_LSU_RRNA	*RPL7L1|RPL7A|RPL35|RPF2|LAS1L|NHP2|URB1|FTSJ3|RPL7|NOL9|DDX18|PES1|ZNHIT6|MRPL1|GTPBP4|RPL10A|BOP1|WDR12|RSL1D1|ZNHIT3*	20	1.9231	0.0408
GO_RNA_PHOSPHODIESTER_BOND_HYDROLYSIS	*TOE1|EXO1|CNOT2|MRPL44|POP7|CNOT6|EXOSC8|PARN|FEN1|YBEY|DGCR8|RPP38|PAN3|PAN2|LACTB2|XRN2|EXOG|ERI1|SMG6|RNASEL|DIS3L|ELAC1|NOL9|DIS3L2|NOP14|ENDOV|SAMHD1|NCBP1|EXOSC7|APEX1|KRI1|TSEN54|ENDOG|CPSF6|DROSHA|RPP25|MOV10|AZGP1|DCP2|FIP1L1|NHP2|NUDT16|ISG20L2|RPS21|EXOSC3|EXOSC5|NOB1|ERI2|USB1|PDE12|PPP1R8|RNASEK|RRP36|XRN1|RNASET2|CPSF7|ERN1|DIS3|RRS1|POP1|RPP14|RCL1|EXD2|EXOSC6|EXOSC4|NCBP2|ERI3|EXOSC1|EXOSC2|EXOSC10|RNASEH1|DCPS|TUT1|ISG20|RNASEH2B|TSNAX|DICER1|EXOSC9|EDC3|TSEN34|CNOT6L|POP4|UTP23|CNOT7|RNASEH2A|CSTF3|CNOT1|ELAC2|ANGEL2|CSTF2|DBR1|TSEN2|TSEN15|BOP1|REXO2|UTP20|SND1|POLR2I|NUDT21|PIWIL2|RPP30|RPP21|CNOT8|TSN|POP5|RPP40|ANGEL1|PCF11|NUDT16L1|POLR3K|ABT1|CPSF3|CSTF2T|CPSF1|PNPT1|HELZ2|ZNRD1|CPSF2|CPSF4*	119	1.9225	0.0406
GO_DENDRITIC_SPINE_MORPHOGENESIS	*EPHA4|CTTN|ARC|NLGN1|CDC42|NLGN3|ITPKA|HDAC6|PDLIM5|CDK5|DHX36|ACTR2|NGEF|LRP8|PPP1R9A|DOCK10|ADAM10|EPHB2|SIPA1L1|HCLS1|OPA1|LRRK2|DBN1|EPHB3|CAPRIN2|DBNL|PTEN|CAMK2B|DNM1L|DNM3|CAPRIN1|UBE3A|BAIAP2|CFL1|PAFAH1B1|SRCIN1|TIAM1|DVL1|ABI2|ARHGAP33|KALRN|CTNND2|DLG4*	43	1.9212	0.0407

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
REACTOME_HDACS_DEACETYLATE_HISTONES	*RBBP7|GATAD2B|HDAC1|PHF21A|CHD3|HDAC8|HDAC10|ARID4B|HMG20B|ARID4A|GATAD2A|CHD4|RBBP4|MBD3|GPS2|MTA2|SUDS3|REST|NCOR1|TBL1XR1|MTA3|SAP30|NCOR2|HDAC2|TBL1X|MTA1|RCOR1|KDM1A|HDAC3|SAP30L|SAP18|BRMS1*	32	1.9157	0.0429
GO_REGULATION_OF_DENDRITIC_SPINE_MORPHOGENESIS	*EPHA4|CTTN|ARC|NLGN1|NLGN3|ITPKA|PDLIM5|CDK5|DHX36|ACTR2|NGEF|LRP8|PPP1R9A|ADAM10|SIPA1L1|HCLS1|LRRK2|OPA1|DBN1|CAPRIN2|DBNL|PTEN|CAMK2B|DNM1L|DNM3|CAPRIN1|BAIAP2|UBE3A|CFL1|PAFAH1B1|SRCIN1|TIAM1|ABI2|ARHGAP33|KALRN*	35	1.9131	0.0437
HALLMARK_MYC_TARGETS_V2	*HSPE1|AIMP2|HSPD1|NOP16|PRMT3|TBRG4|SLC19A1|PES1|TFB2M|WDR74|RCL1|SRM|PHB|GNL3|NPM1|LAS1L|NOC4L|FARSA|IPO4|IMP4|UNG|WDR43|RRP9|BYSL|RABEPK|NIP7|HK2|MCM5|MCM4|PUS1|TCOF1|MYBBP1A|SUPV3L1|DDX18|PA2G4|UTP20|NOLC1|CDK4|RRP12|DCTPP1|NOP56|MPHOSPH10|NOP2|PLK1|NDUFAF4|GRWD1|EXOSC5|MRTO4|MAP3K6|TMEM97|SORD*	51	1.9122	0.0436
REACTOME_TELOMERE_C_STRAND_LAGGING_STRAND_SYNTHESIS	*POLA2|WRN|DNA2|RPA1|CHTF8|PRIM1|RFC5|FEN1|CTC1|RPA2|RFC2|RPA3|RFC1|POLA1|CHTF18|PCNA|POLD3|POLD1|PRIM2|RFC3|LIG1|POLD2|DSCC1|RFC4|BLM*	25	1.9064	0.0461
VILLANUEVA_LIVER_CANCER_KRT19_UP	*CENPO|CENPM|MAP3K4|GINS1|IFFO2|OLA1|RAB13|CKAP2L|THOC1|TDG|KIAA1958|ALMS1|CYTH2|POLA1|CDC20|GLMN|MKI67|RRM1|DDX4|DCLRE1C|NCOA6|DNM1L|FAM126A|ZNF605|PTTG1|ZWINT|STRBP|STMN1|EZH2|MEX3C|RBPJ|KIF4A|CDC25B|ZNF532|CEP55|BLM|USP37|CENPE|HMGXB4|CCDC28B|CASP2|IFT57|TPX2|TROAP|SFMBT1|KIF20A|CEP290|TRMT6|DROSHA|INTS4|ANLN|POLD3|KIF23|MCM8|LMNB1|KNTC1|PIGA|RRP1B|RFX3|MCM6|GNPTAB|DLGAP5|PHTF2|SOX4|GPD2|FANCI|CEP135|CWC22|PCYOX1L|NCAPH|USP4|KIF18A|CDCA3|RAE1|KIAA1841|ADAM17|ARID2|CDC7|SUMO2|STIL|UPF3B|RAD54L|TOP2A|ANP32B|KIF15|KIF20B|BARD1|SOX9|TTK|PTPRA|ZNF292|TAF5|FUBP1|USP28|NDE1|HK2|DNA2|STK4|EPC1|DDX27|WDR75|KIF2C|ZBED5|GOLGA3|DHRS13|CDCA8|SERGEF|GPSM2|BUB1|NAP1L1|METTL8|SIPA1L3|RIC8B|PDZD8|AP1G2|ECT2|NCAPG|METTL9|HJURP|MELK|MCM10|NUAK1|CTNND2|DCLRE1B|NDC80*	125	1.9042	0.0469
GO_MITOCHONDRIAL_RNA_METABOLIC_PROCESS	*GRSF1|ELAC2|MRPL12|EARS2|TRIT1|SLIRP|DARS2|YARS2|TFAM|PUS1|TBRG4|PRKAA1|TRMT61B|SUPV3L1|FOXO3|FASTKD1|FASTKD5|TFB2M|SLC25A33|TEFM|CDK5RAP1|LRPPRC|CHCHD10|TRMT5|TARS2|HSD17B10|TRMT10A|MTO1|PNPT1|TRMT10C|PDE12|AARS2|WARS2|TRNT1|SARS2|POLRMT*	36	1.9022	0.0474
GO_NEGATIVE_REGULATION_OF_MRNA_PROCESSING	*RBM42|SRSF12|DYRK1A|RBMX|U2AF2|SRSF6|RNF40|SFSWAP|HNRNPK|RBM10|PTBP1|CCNT1|NPM1|RNPS1|SRSF9|SUPT5H|HNRNPA2B1|BARD1|SRSF7|HNRNPL|C1QBP|CDK9|CTR9|RNF20|SAP18|SRSF4*	26	1.9014	0.0474
GO_SNRNA_PROCESSING	*EXOSC6|INTS4|INTS1|EXOSC4|TOE1|EXOSC2|INTS9|INTS2|TUT1|EXOSC7|EXOSC8|INTS8|INTS6|INTS7|EXOSC9|EXOSC3|EXOSC5|USB1|INTS3|INTS5|INTS10|INTS12*	22	1.8994	0.0481
GRAHAM_NORMAL_QUIESCENT_VS_NORMAL_DIVIDING_DN	*BUB1B|CENPM|DTL|COTL1|GINS1|PRC1|CCNE2|RAD51AP1|CHEK1|SLC7A5|CKS1B|CCNA2|FEN1|SAC3D1|HAT1|HBB|BIRC5|CDC20|RRM1|CDC45|OIP5|HBD|TOP2A|MINPP1|NUSAP1|RFC3|ZWINT|KIF15|SNRNP25|CDC6|CSE1L|CDK1|CEP55|RRM2|SMC2|VDAC3|NPM3|FABP5|RNASEH2A|APOBEC3B|MAD2L1|GMNN|DUT|MCM5|TYMS|MCM2|RACGAP1|VRK1|MCM4|KIF2C|TRIP13|POLE2|PCNA|BUB1|NUP85|AMMECR1|CCNB2|MCM6|KIF11|KIF18B|NCAPG|CDKN3|DLGAP5|GINS2|MELK|MSH2|PPIF|MCM10|DSCC1|RFC4|TK1|GGH|NDC80*	73	1.8965	0.0492
GO_NEGATIVE_REGULATION_OF_CYTOSKELETON_ORGANIZATION	*SWAP70|BBS4|NEK2|CAPZA1|CLASP2|ARAP1|CAPZA2|ARFGEF1|CLIP3|PFN2|PRKCD|LIMA1|PPP1R9A|TMEM67|TMOD2|GMFB|CAPZB|MAPRE1|MYADM|PICK1|FKBP4|TUBB4A|CAMSAP1|NPM1|SPTAN1|CORO2B|STMN1|MAP2|CORO1B|TRIOBP|KAT2B|TRIM37|KANK1|TMSB10|HIP1R|SPTBN1|SMAD4|BRCA1|CAPG|NUBP1|CCNF|TMOD1|TMOD3|SPTA1|GSN|TAOK1|DYRK1A|HDAC6|PHLDB2|MID1|EPS8|INPP5K|MID1IP1|TMSB4X|PFN1|RDX|DLC1|PLEKHH2|TBCD|CAMSAP2|ADD1|KATNB1|CLASP1|TWF2|TWF1|KAT2A|EML2|SPTBN2|ARHGEF2|MDM1|CIB1|MAP1B|APC2|CKAP2|CDK5RAP2|PPFIA1|CORO1A|APC|CHMP2A|ADD3|WASF2*	81	1.8957	0.0491

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
REACTOME_POSITIVE_EPIGENETIC_REGULATION_OF_RRNA_EXPRESSION	*TWISTNB|GATAD2B|TBP|RBBP7|HDAC1|CHD3|TTF1|GSK3B|MYO1C|MYBBP1A|EHMT2|EP300|GATAD2A|CHD4|RBBP4|POLR1C|MBD3|MTA2|POLR1A|POLR1B|POLR2F|MTA3|BAZ1B|SMARCA5|DEK|TAF1C|POLR2E|TAF1B|DDX21|KAT2A|HDAC2|SF3B1|MTA1|KAT2B|CD3EAP|POLR1E|POLR1D|POLR2K|POLR2L|POLR2H|ZNRD1|ACTB|ERCC6*	43	1.8933	0.0499
AFFAR_YY1_TARGETS_DN	*BUB1B|EXO1|MATN2|PTGDS|RAD51AP1|HMGB1|HMMR|SLC35C2|FEN1|NSDHL|CLEC3B|HMGCS1|RBBP4|HMGB3|REST|POLA1|MKI67|PRDX4|LIG1|STMN1|AURKB|SUV39H2|CDC6|SCARB1|KHDRBS1|MTCH2|ABHD3|ZNF143|BCAT1|UNG|FUS|MAD2L1|KIF22|SLC25A26|FDPS|TRIB3|RAD18|CENPE|AURKA|MCM5|SLC4A4|DIAPH3|CREB1|TTF1|MCM3|LRIG1|MCM4|UHRF1|ELAVL3|CENPH|NASP|JMJD6|SLC29A1|SPP1|FMOD|KIF20A|SERPINA1|FDFT1|SLC25A5|LDLR|LIG3|FADS2|HMGB2|NIPSNAP1|TERF1|EEF1A1|KIF23|SHCBP1|MCM7|CCNB1|LMNB1|TACC3|PIGA|SLC4A10|PLK1|SPA17|MCM6|DKK3|ALDH18A1|TFAP4|SFXN1|MRPL52|MSH2|CYP51A1|RFC4|PLCB1|PER3|PRC1|IDH1|CDC25C|OTC|FOXM1|IDI1|CDCA3|TCP1|CDT1|CCNA2|TGFBR1|DNAJC2|PRKG2|BIRC5|PTPN2|CHTF18|COL6A3|SLC22A18|LYZ|TOP2A|PRPS1|RPS6KA4|IGFBP5|ANP32E|CHST2|TTK|ATP6V1E1|TFB1M|B3GAT3|SMC2|SPAG5|POLH|ANKH|PFDN5|FN3K|IFT80|MSH3|CENPF|RACGAP1|API5|PTGS1|APOC1|KIF2C|SCD|GNB4|THY1|ASPM|BUB1|DHCR24|SNX5|HELLS|TUBB2A|CCNB2|SETD1A|KIF11|SQLE|NCAPG|RAB27A|PDGFRA|MTHFD2|MRPL19|ELOVL6|TK1|FARS2|FZD3*	152	1.8931	0.0494
REACTOME_EPIGENETIC_REGULATION_OF_GENE_EXPRESSION	*SIN3A|GATAD2B|RBBP7|SAP30BP|MTF2|DNMT3B|MNAT1|GSK3B|MYO1C|TDG|EHMT2|GATAD2A|RBBP4|SAP130|MTA2|SUDS3|POLR1A|POLR1B|SMARCA5|DNMT3A|CDK7|TAF1B|SIRT1|DDX21|HDAC2|GTF2H4|EZH2|SF3B1|KAT2B|UBTF|POLR2L|GTF2H1|ACTB|SAP30L|ERCC6|TWISTNB|ERCC3|TBP|HDAC1|PHF1|ERCC2|CHD3|BAZ2A|TTF1|UHRF1|AEBP2|MYBBP1A|SUZ12|ARID4B|EP300|CHD4|POLR1C|MBD3|RRP8|POLR2F|GTF2H3|SUV39H1|MTA3|DNMT1|BAZ1B|DEK|SIN3B|SAP30|TAF1C|CCNH|POLR2E|KAT2A|TET2|MTA1|EED|CD3EAP|POLR1E|POLR1D|POLR2K|PHF19|POLR2H|ZNRD1|MBD2|SAP18*	79	1.8905	0.0503
GO_REGULATION_OF_MITOCHONDRIAL_GENE_EXPRESSION	*MRPS27|ALKBH1|CDK5RAP1|LRPPRC|MPV17L2|CHCHD10|SHMT2|RPUSD4|TSFM|MALSU1|COA3|RMND1|MTG1|FASTKD2|PRKAA1|NSUN4|C1QBP|FASTKD3|NGRN|TRMT10C|NSUN3|TRUB2|RPUSD3*	23	1.8886	0.0508
GO_SNRNA_METABOLIC_PROCESS	*INTS1|TOE1|DKC1|INTS9|INTS2|EXOSC7|MEPCE|METTL16|EXOSC8|INTS8|INTS6|INTS3|INTS5|INTS12|EXOSC6|INTS4|EXOSC4|EXOSC2|EXOSC10|TUT1|NHP2|ZCCHC8|NOP10|RBM7|INTS7|EXOSC9|EXOSC3|EXOSC5|USB1|INTS10*	30	1.888	0.0505
LI_WILMS_TUMOR_VS_FETAL_KIDNEY_1_DN	*BUB1B|GTF3C2|CDH2|SHMT2|CHN1|PCBP2|CDK2|FEN1|NME1|CACNB3|MSH6|CDC20|ANKLE2|MKI67|RRM1|PRIM2|KPNA2|PTTG1|STMN1|EZH2|AURKB|CHAF1A|RSRC2|CDK1|POLE3|BRCA1|SNRPA1|UNG|CCND2|BLM|MAD2L1|NUP188|TXNRD1|DKC1|SMC4|AURKA|XPOT|TIA1|PARP1|TOPBP1|PRRC2B|MCM2|TPX2|FZD7|DNAJC9|RFC5|TIMELESS|KIFC1|NASP|DDX1|TRIP13|CADM1|YAF2|NOLC1|PCNA|SV2A|LIG3|MYL6B|BCL7A|FADS2|NUP205|KIF23|FADS1|BUB3|ST6GAL1|LMNB1|SS18|DLG5|CCT3|MPHOSPH9|MCM6|LRP4|DLGAP5|MLXIP|DDX52|SRPK1|CRABP2|MSH2|MAP4K4|FANCI|CDC25C|WASF3|ESYT1|CKS1B|BAZ1A|ZNF423|PBX3|TARBP2|NCBP2|SNRPF|TOP2A|GPC1|PFKP|PRPF40A|ASNS|PPP2R2A|CIT|CKAP5|TTK|SPAG5|ABCA2|STRAP|TAF5|RNASEH2A|APOBEC3B|KIF14|ZNF516|PRIM1|CENPF|SACS|ELOVL2|CKS2|SALL2|ESPL1|KIF2C|UCK2|ACP1|XRCC5|ILF2|BOP1|SSRP1|BAZ1B|CBX5|NR2C1|NAP1L1|SCRN1|SIX1|TCERG1|EYA1|CCNB2|KIF11|NELL2|CDKN3|SLC16A1|MELK|TP53BP2|BTAF1|YWHAZ|MTHFD2|DDX23*	140	1.8866	0.0508

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
CROONQUIST_NRAS_SIGNALING_DN	*BUB1B|WEE1|NCAPH|EIF5|GINS1|CDC25C|FOXM1|CHEK1|CKS1B|CCNA2|SPC25|STIL|CDC20|MKI67|OIP5|TOP2A|RFC3|ZWINT|PTTG1|STMN1|AURKB|PLOD2|CHAF1A|CDC6|CSE1L|CDK1|TRAIP|SPAG5|SMC2|SBNO2|SNRPA1|MYBL2|CHEK2|APOBEC3B|KIF22|DUT|AURKA|SMC4|MCM2|MCM3|TPX2|MCM4|GALE|KIF2C|BRD8|NASP|UBE2C|TRIP13|PCNA|POLD3|POLD1|HMGA1|HMGB2|GPX4|MCM7|CCNB1|PLK1|CCNB2|RAD51C|KIF11|CDKN3|TK1|NDC80*	63	1.8819	0.053
CHEMNITZ_RESPONSE_TO_PROSTAGLANDIN_E2_UP	*BUB1B|PEA15|TPD52|ANAPC1|SHMT2|URB1|PCGF1|ATP6V1C1|FBXO17|NOP16|SLC39A14|POLR3D|RPS9|ASF1B|SAE1|MKI67|ASMTL|PTTG1|MLLT11|NUP210|CHAF1A|GMPS|CDC6|TGFB1I1|MICALL1|RRM2|PCBD1|AFAP1L2|WDR76|KSR1|KPTN|CENPE|ARAP3|SMC4|AURKA|ADAM19|XPOT|TPX2|MCM4|DGAT1|UHRF1|SKA3|UBE2C|LARP1|KIF20A|ATAD2|MTA3|TGS1|ANK2|SNRPA|CCNB1|LMNB1|TRIM28|NECAB3|SPDL1|UAP1|WDFY2|DLGAP5|NCAPH|CHMP7|PRC1|NSMAF|SLC7A1|FAM171B|AP2S1|BOLA3|RAB15|GEMIN5|PWWP2A|IMPAD1|BIRC5|DNAJC18|GRAMD1A|CDC45|NPM1|TOP2A|KIF3C|NUSAP1|FANCL|AFAP1L1|RPL8|ERCC1|HSPA9|BARD1|IQGAP3|TTK|NES|SPAG5|RFTN1|GTSE1|RNASEH2A|BRIP1|PRR11|CHD1L|UBE2S|AKAP17A|CENPF|CKS2|LRRC8C|EIF4EBP1|ASPM|GJC1|PAICS|FEZ1|BUB1|STAMBPL1|PRAF2|CCNB2|CDKN3|NCAPG|SLC16A1|SH3KBP1|HJURP|MTHFD2|TK1|MZT2B*	116	1.879	0.0542
PUJANA_BRCA_CENTERED_NETWORK	*NFYB|GINS1|RAD51AP1|DDX46|SKP2|HMMR|ABCB7|AATF|TOP1|RBBP4|TFDP1|ZNHIT3|POLA1|CDC20|RRM1|ASF1A|POLR2B|RFC3|METAP1|EZH2|PPP2R5C|CHAF1A|CDK1|SEC31A|BRCA1|RBBP8|SNRPA1|UNG|BLM|MYBL2|MAD2L1|DUT|CNOT3|EIF3H|AURKA|SMC4|MCM5|RPA1|SMC1A|DDX39A|SMC3|TOPBP1|TAF11|MCM2|MCM4|SUZ12|RAD21|PRKDC|TIMELESS|RAD1|NASP|KIFC1|UBE2C|TCF3|PCNA|DNMT1|COPS3|SNRPA|DEK|TTF2|HMGB2|TMPO|DCP2|MED20|BUB3|LMNB1|CSNK2A1|NCAPD2|MCM6|RECQL|MSH2|RFC4|FANCI|SLC7A1|NAE1|CCNA2|ATM|CDC7|RAD54L|ZNF330|PSIP1|TOP2A|PRPS1|DDX39B|RNASEH2B|RB1|SMC2|PPP1CC|CHEK2|DNA2|LBR|BRCA2|TBCA|SNRPB|PRPF4|ESPL1|MAT2A|KATNA1|PAICS|SRSF11|SSBP2|TCERG1|POLE|CAD|RAD51C|XPO1|IDH3B|NCK1|CPSF4|NDC80*	110	1.8764	0.0551

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
GOBERT_ OLIGODENDROCYTE_ DIFFERENTIATION_UP	*MEF2C|LIMK1|EXOSC8|SKP2|ISOC1|SPARC|NEURL1B|PBK|NLE1|RBBP4|CCDC61|NUP133|CDC20|PRIM2|GNL1| TMEM109|CEP89|ZC3H8|PTTG1|STMN1|ANKLE1|NUP210|SUV39H2|SKA1|SASS6|CDCA7L|CCNF|UMPS|LIN9| RAD18|CENPE|FANCA|SERPINE2|LYAR|SKA3|RNF26|AIDA|TROAP|NUCKS1|MNS1|HAUS8|RIF1|GAP43|KNTC1| TACC3|PLK1|SPDL1|NT5DC2|PPIF|NET1|LRR1|CCDC34|TEAD1|AAAS|FN1|PRC1|KIF18A|FOXM1|CEP192|SART3| FSTL1|SALL3|CCNA2|SLC1A3|CTC1|GEMIN6|STIL|GPC6|RAD54L|CCNK|FAM83D|OIP5|NUSAP1|TONSL|NOC2L| KIF20B|PAFAH1B3|ANP32E|GPATCH4|SMC2|SNX25|CLIC1|CHEK2|INCENP|ZNF367|ANXA2|CMC2|CENPN|XRCC1| TRMT61A|CDCA8|CHAF1B|STAG1|SPRED2|SPATS2L|ZBTB12|ASPM|CACNG4|RRP12|RC3H2|HAUS4|SLBP|LARP7| UCHL5|TAF15|KIF18B|NCAPG|CDKN3|CKAP2|GINS2|ARHGAP19|HJURP|MCM10|NEK2|CENPM|DTL|GINS1| NCAPH2|CDK2|NUP54|SLC25A10|PEG3|HIRA|DYNLL1|ASF1B|FAM111A|POLA1|NMRAL1|FBXO5|KPNA2|CENPQ| WDR62|TRPS1|CLSPN|MAP2|EZH2|NUP43|ARHGAP11A|KIF4A|LIMCH1|DBF4|CDC6|RSRC2|CDK1|NFIB|RRM2| SAMHD1|CENPL|UNG|VOPP1|BLM|POLR2A|E2F1|E2F7|GMNN|ANKS1A|SMC4|AURKA|FMNL3|PTOV1|LIN54| PKMYT1|GOLT1B|HMGN5|MCM2|C12ORF10|MCM3|TPX2|DNAJC9|MCM4|RHOT2|UHRF1|RFC5|ATAD5|TIMELESS| ALAD|GFOD2|NASP|UBE2C|RFC2|SRGAP2|POLE2|KIF20A|SUV39H1|NOLC1|ATAD2|RBM10|DNMT1|DCTPP1| POLD3|POLD1|DDX20|TERF1|OSBPL3|MCM8|KIF23|LASP1|SHCBP1|MCM7|NUP85|CCNB1|PALB2|SPPL2A|RRP1B |RCC1|NCAPD2|NCL|MCM6|CTDSPL2|ZWILCH|ERI2|TMEM97|RFC4|ITGB3|CDCA7|CDCA2|CDC25C|ASPH|TGIF2| USP1|FANCD2|FBN2|THYN1|CDC45|TICRR|GAS2L3|SHQ1|SEPHS1|PBXIP1|CKAP5|SPAG5|DDX11|DNAAF2|CSRP2| HDAC4|C1ORF112|BEND3|PHF1|IMPA2|TCOF1|GPR19|HELLS|POLD2|PTGES2|POLE|PHF19|ZNRD1|DSCC1| RBMX2|TK1|IFRD2|RECQL4|WEE1|EME1|IFFO2|CKAP2L|S100A4|CHEK1|MIS18A|CDCA5|HMMR|PDLIM1|CENPT| FEN1|ID1|TDP2|LANCL2|ZRANB3|HMGN2|LIG1|SHMT1|RANGAP1|CEP55|LSM2|VIM|MYBL2|MAD2L1|IGF1R| KIF22|CBR3|TCF19|RPA1|CREB5|LDHB|CENPH|NSL1|SMO|CENPK|TTF2|PALLD|LMNB1|ETAA1|DLGAP5|C7ORF50| ORC1|LPCAT4|KIAA0586|RAD51|POLA2|PDSS1|NUP107|TIPIN|PTGR1|CDCA3|NPTXR|SKA2|CDT1|CKS1B|PTN| HAT1|POC1B|CDC7|BLVRB|CHTF18|CEP152|BATF3|UBE2T|PASK|IQGAP3|NES|HIRIP3|GTSE1|CPNE8|PRR11| PDZRN3|DNA2|CASP3|PRIM1|LSM4|ESPL1|KIF2C|PA2G4|RPA2|MREG|HAUS5|SNX7|STAMBPL1|CCDC77|CCNB2 |KIF11|PSRC1|XPO1|GRWD1|NDC80|BUB1B|EXO1|L3MBTL2|CCNE2|RAD51AP1|GEMIN2|ENKD1|JAK1|SPC24| CENPP|MIS18BP1|SPC25|ADAM23|ALDH16A1|MAD1L1|CHSY1|AKAP12|HMGB3|MSH6|CCDC18|CASP7|MKI67| RRM1|IFIT2|RFC3|STUB1|AURKB|LMNB2|PPP2R5C|PLEKHO1|CDC25B|TAF4|DDAH1|LSM5|WDR76|DUT|WDHD1| DKC1|MCM5|TYMS|DCTD|DUSP12|NUF2|HAUS3|VRK1|MTSS1|TAMM41|KIFC1|TRIP13|DLGAP1|LDLR|RBL1| TEX30|ERAL1|HMGB2|MLEC|FBXL18|CCND3|PODXL|PSMC3IP|TPM1|CDH6|FANCI|MDP1|SIVA1|NCAPH|MMS22L |MDC1|GEMIN5|NUP37|HAUS1|SRM|BIRC5|TOP2A|VCAN|CIT|TRAIP|CENPI|TTK|ROCK1|TAF5|ESCO2|PABPC1| BRCA2|CENPF|RACGAP1|LPIN2|CKS2|FIGNL1|RAD50|HAUS6|BUB1|NOP58|CAND2|ANXA1|ECT2|CENPW|TBL2| MELK|ERCC6L|NCAPG2*	445	1.8732	0.0567

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
GO_MACROMOLECULE_METHYLATION	*RAB6A|CARM1|ZNF335|MTF2|MIS18A|WDR4|DMAP1|TARBP1|WDR5|EHMT2|WDR82|GATAD2A|PCMT1|MPHOSPH8|THUMPD2|CTCF|PWP1|GSK3A|PRMT6|MECP2|SIRT1|TDRD5|TRMT10A|SUV39H2|SNRPD3|NSUN6|SMAD4|ICMT|THADA|NSUN3|ATRX|ZMPSTE24|MLLT6|METTL2B|FTSJ3|METTL2A|CXXC1|PRMT2|METTL6|PAGR1|RLF|RNMT|FAM98A|PRMT1|PYGO2|LMNA|RIF1|TGS1|ETF1|CAMKMT|RBM15|TET2|MTO1|EED|SMYD2|BCDIN3D|SMARCB1|GNAS|MBD2|RRNAD1|DNMT3B|RBBP5|RBM15B|TRMT61B|NSUN4|PIK3CA|SETD5|MEN1|COPRS|ZNF274|LCMT1|GTPBP3|CTNNB1|METTL3|MTHFR|TTLL12|SETD6|TFB1M|SETD3|CTR9|DIMT1|IWS1|METTL1|FBL|SNW1|GSPT1|KDM6A|BAZ2A|NSUN2|BCOR|PPM1D|TRMT61A|CHTOP|ZCCHC4|TRMT1L|OGT|METTL8|NOP2|SETD1A|KDM1A|ALKBH8|METTL4|TRMT10C|KDM4C|LCMT2|PRDM2|RAB3D|MEPCE|METTL16|WTAP|PRMT3|METTL14|MTRR|SETMAR|FTSJ1|PICK1|DDX4|PAXIP1|EZH2|ASH2L|PIH1D1|BRCA1|ZC3H13|CBLL1|SETD2|SETD7|FBXO11|METTL15|NSD1|PARP1|N6AMT1|PCIF1|SUZ12|TRDMT1|MBD3|NDUFAF7|TRMT6|SUV39H1|DNMT1|SETD1B|SUPT6H|MECOM|KPNA7|TRIM28|NSUN5|NTMT1|DOT1L|RNF20|MRM1|FBLL1|TRMT1|PRMT5|SMYD3|TFB2M|MTA2|TYW3|EHMT1|PCMTD1|DNMT3A|WDR61|TRMT13|TRMT11|THUMPD3|EZH1|AUTS2|TRMT112|MGMT|TRMT2A|PRMT7|RTF1|PCMTD2|KDM4D|BEND3|PHF1|PAF1|SNRPB|ARID4B|ARID4A|ATF7IP|TDRKH|KDM3A|PIWIL2|SETDB1|KDM1B|TRMT5|EMG1|METTL21A|HSD17B10|PHF19|ASH1L|RAB3B|BRD4|FAM98B|BHMT*	194	1.8717	0.057
ZHOU_CELL_CYCLE_GENES_IN_IR_RESPONSE_6HR	*RAD51|NEK2|EXO1|GPN3|DTL|NCAPH2|CDCA5|CDT1|NUP88|CCNA2|CDK2|TPRKB|USP1|QSER1|DCLRE1A|HMGB3|RAD54L|POC1A|FBXO5|NUSAP1|EZH2|UBE2T|RTKN2|TTK|CEP55|SMC2|BRCA1|MYBL2|FABP5|E2F1|MAD2L1|KIF22|GMNN|WDHD1|E2F8|MCM5|DSN1|LBR|CMC2|TOPBP1|MCM2|MCM3|DNAJC9|HAUS3|RACGAP1|UHRF1|RFC5|GINS3|TIMELESS|RPA2|RANBP1|HAUS8|KIFC1|CDCA8|CHAF1B|TRIP13|KIF20A|PAICS|DCTPP1|CENPK|DEK|SAP30|HMGB2|MCM7|LMNB1|KNTC1|MCM6|KIF11|DLGAP5|GINS2|DTYMK|RFC4*	72	1.8706	0.0571
GO_RNA_3_END_PROCESSING	*TOE1|APP|PAPOLA|INTS2|THOC1|EXOSC8|INTS6|PAPOLG|PARN|CDC40|CASC3|ZC3H11A|ERI1|SARNP|SRSF9|PTCD1|ELAC1|PABPN1|SRSF3|ZFP36L1|GRSF1|POLDIP3|NCBP1|DKC1|DDX39A|EXOSC7|INTS8|U2AF2|CSTF1|SUPV3L1|SRSF6|RNF40|THOC7|CPSF6|SRSF1|WDR33|SRSF2|SNRPA|CCNT1|FIP1L1|SSU72|MAGOH|CCNB1|MTPAP|THOC2|SUPT5H|RPS21|EXOSC3|EXOSC5|USB1|TRNT1|RNF20|ZC3H3|ALYREF|SRSF4|INTS1|RPRD1B|FBLL1|POLR2D|CPSF7|CLP1|DHX36|LSM11|SCAF8|INTS5|UPF3B|EXOSC6|EXOSC4|NCBP2|ERI3|RNPS1|EXOSC2|EXOSC10|TUT1|SRRM1|LEO1|DDX39B|EIF4A3|THOC3|INTS7|EXOSC9|SYMPK|BARD1|SLU7|CTR9|RBM8A|CSTF3|SRSF5|DHX38|ELAC2|RPRD2|FBL|RPRD1A|PAF1|PABPC1|CSTF2|THOC5|CHTOP|NUDT21|INTS12|HSF1|SRSF11|SSB|HSD17B10|THOC6|SLBP|PCF11|POLR3K|CPSF3|SRSF7|CSTF2T|CPSF1|PNPT1|CDK9|TRMT10C|CPSF2|CPSF4|AHCYL1|CDC73*	119	1.8669	0.059
GO_DNA_METHYLATION_OR_DEMETHYLATION	*DNMT3B|ALKBH4|MIS18A|DMAP1|TDG|MTRR|PRMT5|PIK3CA|EHMT2|GATAD2A|ALKBH3|MTA2|MPHOSPH8|EHMT1|APOBEC3G|PICK1|DDX4|CTCF|DNMT3A|ALKBH2|GSK3A|MECP2|TDRD5|EZH2|OTUD4|BRCA1|MGMT|ATRX|APOBEC3B|PRMT7|ALKBH1|BEND3|ZMPSTE24|BAZ2A|PARP1|APEX1|N6AMT1|FTO|PPM1D|ATF7IP|TDRKH|RLF|MBD3|PIWIL2|DNMT1|KDM1B|TRIM28|TET2|USP9X|USP7|METTL4|GNAS|MBD2*	53	1.864	0.0603
GO_METAPHASE_ANAPHASE_TRANSITION_OF_CELL_CYCLE	*BUB1B|ANAPC1|RIOK2|CDT1|TEX14|ATM|XRCC3|NEK6|MAD1L1|CDC23|MAD2L2|CUL3|CDC20|ZW10|FBXO5|LCMT1|AURKB|RB1|CDC6|TTK|ANAPC5|MAD2L1|CENPE|ZNF207|PCID2|CENPF|ANAPC4|KLHL22|CDC27|RAD21|ESPL1|CDC26|TRIP13|TPR|BUB1|GEN1|BUB3|CCNB1|TACC3|PLK1|ANAPC11|SPDL1|PSMG2|DLGAP5|DYNC1LI1|CDK5RAP2|APC|HECW2|IK|NDC80|NSMCE2*	51	1.8634	0.0601

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
GO_ERROR_FREE_TRANSLESION_SYNTHESIS	*PCNA|RFC1|UBA52|RPS27A|REV1|RPA1|RFC3|UBB|SPRTN|RFC5|RPA2|RCHY1|POLH|RFC2|RFC4|RPA3|VCP|NPLOC4*	18	1.8605	0.0613
GO_REGULATION_OF_SISTER_CHROMATID_SEGREGATION	*BUB1B|ANAPC1|HNRNPU|RIOK2|TNKS|CDCA5|CDT1|TEX14|FEN1|ATM|XRCC3|NEK6|MAD1L1|CDC23|MAD2L2|CUL3|CDC20|CTCF|ZW10|FBXO5|LCMT1|NUMA1|PTTG1|CTNNB1|AURKB|SMC5|NIPBL|RB1|CDC6|TTK|DDX11|ANAPC5|ATRX|NAA10|MAD2L1|CENPE|ZNF207|PCID2|CENPF|ANAPC4|HDAC8|KLHL22|CDC27|RAD21|ESPL1|CDC26|TRIP13|TPR|RMI2|BUB1|GEN1|BUB3|CCNB1|TACC3|SFPQ|PLK1|ANAPC11|SPDL1|PSMG2|DLGAP5|DYNC1LI1|CDK5RAP2|APC|HECW2|BECN1|IK|NDC80|NSMCE2*	68	1.8593	0.0614
REACTOME_PKMTS_METHYLATE_HISTONE_LYSINES	*NSD1|NFKB2|RBBP7|RBBP5|AEBP2|WDR5|SUZ12|EHMT2|ATF7IP|RBBP4|SMYD3|EHMT1|NFKB1|SUV39H1|RELA|SETDB1|SETD1B|EZH2|MECOM|SUV39H2|EED|SETD1A|DOT1L|SETD6|ASH2L|SMYD2|ASH1L|SETD3|SETD7|SETD2*	30	1.8592	0.0609
GO_POSITIVE_REGULATION_OF_VIRAL_TRANSCRIPTION	*DHX9|GTF2B|CTDP1|CHD1|SNW1|GTF2F2|POLR2G|POLR2D|TAF11|JUN|EP300|LEF1|NUCKS1|POLR2I|POLR2F|RSF1|CCNT1|POLR2B|POLR2E|POLR2J|SUPT4H1|RRP1B|ZNF639|POLR2C|SUPT5H|POLR2K|SMARCB1|POLR2L|SMARCA4|POLR2H|TFAP4|SP1|CDK9|GTF2F1|POLR2A*	35	1.8589	0.0605
GO_MATURATION_OF_5_8S_RRNA_FROM_TRICISTRONIC_RRNA_TRANSCRIPT_SSU_RRNA_5_8S_RRNA_LSU_RRNA	*ERI3|ERI1|EXOSC2|EXOSC10|EXOSC7|URB1|FTSJ3|EXOSC8|NOL9|KRI1|EXOSC9|RPS21|NOP14|RRS1|ABT1|EXOSC3|PES1|BOP1|UTP20|WDR12|RCL1*	21	1.8586	0.0601
WINNEPENNINCKX_MELANOMA_METASTASIS_UP	*NEK2|EXO1|MRPS5|OLA1|HSPD1|CDCA5|CHEK1|NME1|SPC25|PLEKHG2|EEPD1|MSH6|PCDH17|PRIM2|SMARCA5|PWP1|KPNA2|SSR3|PTTG1|ZWINT|C9ORF40|HTRA2|CDC6|GMPS|MRPS16|CDK1|CEP55|RRM2|MRPL32|SUPT7L|GMNN|NCBP1|AURKA|TYMS|SNRPG|PHF14|NUF2|MCM4|UHRF1|RFC5|TIMELESS|RSRC1|ENY2|RANBP1|NASP|UGGT1|FAM98A|TRUB2|HSPA5|CCT7|CACYBP|PCNA|ATAD2|ANLN|DONSON|SHCBP1|NANS|CCNB1|KNTC1|MRPS17|MCM6|DLGAP5|CHORDC1|MAP4K4|PSMC3IP|RFC4|DNAJA1|MRPS10|NCAPH|HSPA4|GPN3|PRC1|RBMX|SKA2|CKS1B|GEMIN6|DCBLD2|BIRC5|CMSS1|RAD54L|NEIL3|FERMT2|CDC45|TOP2A|CCT4|IMMT|PLOD2|UBE2T|SMC2|SPAG5|OGG1|GLRX2|PRPF38B|IPO7|IWS1|SRP19|ZNF367|NUDCD1|CENPN|CENPF|CCT5|RACGAP1|CKS2|TCOF1|DDX18|KIF2C|ARF4|CTNNAL1|CHTOP|CDCA8|RPA3|GJC1|ASPM|PAICS|CREM|RBM33|CLASP1|BUB1|UBFD1|CCNB2|KIF11|ECT2|XPO1|KIF18B|SURF4|NCAPG|CDKN3|GINS2|MELK|DTYMK|NCAPG2|DSCC1|C8ORF33|TK1|NUDT4|VMA21|NDC80*	137	1.8581	0.0599
GO_NEGATIVE_REGULATION_OF_PROTEIN_POLYMERIZATION	*BBS4|TMOD3|TMOD1|CAPZA1|SPTA1|CAPZA2|ARFGEF1|GSN|DYRK1A|CLIP3|PFN2|PRKCD|EPS8|TMOD2|TMSB4X|PFN1|RDX|CAPZB|TBCD|MAPRE1|MYADM|FKBP4|ADD1|TUBB4A|TWF2|TWF1|SPTAN1|STMN1|MAP2|EML2|TRIOBP|SPTBN2|KANK1|TMSB10|HIP1R|SPTBN1|CAPG|ADD3|VDAC2*	39	1.8571	0.06
KEGG_LYSINE_DEGRADATION	*EHHADH|PLOD3|DLST|NSD1|BBOX1|PIPOX|ACAT2|OGDH|AASDHPPT|AASS|EHMT2|ECHS1|SETMAR|EHMT1|SUV39H1|SETDB1|SETD1B|HADHA|HADH|ALDH7A1|TMLHE|ALDH1B1|PLOD2|ALDH9A1|GCDH|SUV39H2|ALDH2|ACAT1|SETD1A|DOT1L|ALDH3A2|AASDH|ASH1L|PLOD1|SETD7|SETD2*	36	1.8551	0.0608

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
GO_MITOTIC_NUCLEAR_DIVISION	*CHMP1A|TTN|PIN1|TNKS|CHEK1|CDCA5|AURKAIP1|TEX14|PDGFRB|PHIP|TUBG1|BCCIP|XRCC3|NEK6|CUL3|CDC20|PPP1R9B|AKAP8|NAA50|PTTG1|FLNA|NSFL1C|DIS3L2|SMC5|MYBL2|ATRX|KIF3B|MAD2L1|KIF22|CUL9|CENPE|RAN|DSN1|SEH1L|ANAPC4|PDXP|RAD21|RANBP1|KPNB1|NSL1|TPR|CENPK|PINX1|TACC3|KNTC1|PLK1|ANAPC11|SPDL1|PPP2R1A|DLGAP5|DYNC1LI1|CDK5RAP2|RPL24|HECW2|INSR|AAAS|CHMP7|KIF18A|PRC1|INO80|CEP192|CDT1|RRS1|ATM|CCSAP|FBXW5|ZW10|LCMT1|NUMA1|NUSAP1|KIF20B|WRAP73|SMC2|GOLGA2|CHEK2|PDS5B|UBE2S|INCENP|ZNF207|SH2B1|PCID2|EPS8|MIS12|SPAST|KIF2C|NCAPD3|ESPL1|CDCA8|STAG2|STAG1|NDEL1|CLASP1|KIF11|CHMP5|PSRC1|KIF18B|NCAPG|APC|BECN1|IK|NDC80|ARHGEF10|BUB1B|NEK2|PHF23|ANAPC1|RIOK2|NCAPH2|DRG1|CDC42|UBXN2B|TOM1L2|CAV2|BMP7|HIRA|MAD1L1|CDC23|MAD2L2|MKI67|FBXO5|BOD1|ZWINT|AURKB|KIF4A|NIPBL|CDC6|NME6|MSTO1|SIRT7|VPS4B|NAA10|MTBP|SPICE1|SMC4|AURKA|CHMP4A|PDS5A|CHMP6|SMC1A|MAD2L1BP|PKMYT1|SMC3|NUF2|TPX2|KIFC1|UBE2C|CDC26|TRIP13|CDKN1B|ANLN|KATNB1|KIF23|BUB3|AKAP8L|CCNB1|CHMP4B|RCC1|NCAPD2|RHOA|PSMG2|RAB11A|LRP5|NSMCE2|NCAPH|CLASP2|HNRNPU|CTDP1|CDC25C|PPP2R2D|PHF13|DAPK3|PIBF1|PRMT5|BIRC5|CHMP2B|CHMP1B|KIF4B|NFE2L1|CEP97|OBSL1|RB1|TTK|SPAG5|KIF2A|ANAPC5|MAP9|KIF14|NDE1|CHTF8|CENPF|MAU2|RACGAP1|CDKN1C|KLHL22|CDC27|NUP62|VPS4A|PHB2|SIRT2|USP16|BUB1|GEN1|POGZ|CHAMP1|CHMP2A|DSCC1|CDK13|CEP85*	208	1.8534	0.0614
GO_HISTONE_H4_ACETYLATION	*YEATS4|PER1|MSL1|TADA3|DMAP1|KAT8|MORF4L1|WDR5|HAT1|KAT5|RUVBL1|TRIM16|ARRB1|MORF4L2|KANSL2|KANSL3|ACTL6B|NAA50|SIRT1|ATG5|NAA40|MSL2|TRRAP|AUTS2|PIH1D1|CTBP1|BRCA1|IWS1|ACTL6A|BEND3|ZMPSTE24|KAT7|MEAF6|BRCA2|EP400|HCFC1|EPC1|USP22|BRD8|EP300|LEF1|MSL3P1|NCOA1|ING4|ING3|KANSL1|MCRS1|OGT|KAT2A|APBB1|MSL3|SMARCB1|RUVBL2|PHF20*	54	1.8533	0.061
FISCHER_G2_M_CELL_CYCLE	*BUB1B|EIF4E|WEE1|NEK2|NFYB|STAT1|CKAP2L|TNPO2|NUP50|GIT2|HMMR|TGIF1|TDP1|UBE2G1|HMG20B|ZMYM1|CEP350|PBK|SMTN|HMGB3|SLC25A24|CDC20|MKI67|KIF5B|AMD1|TJP1|DCLRE1C|KPNA2|PTTG1|AURKB|ARHGAP11A|DBF4|PPP2R5C|PLAU|CDC25B|DZIP3|CDK1|CEP55|CENPL|CCNF|ZNF267|NUP98|TNFAIP8L1|MAD2L1|KIF22|TUBB|CENPE|PNRC2|TGFB2|DNAJB1|AURKA|PPP1R10|ZNF614|NUF2|MID1|TPX2|CLK4|EIF2AK3|RAD21|HP1BP3|TROAP|PLEKHA5|BRD8|CFLAR|KIFC1|UBE2C|ACSL4|NIF3L1|TRIP13|KIF20A|LDLR|CDKN1B|ANLN|TTF2|HMGB2|TMPO|DCP2|KIF23|SHCBP1|BUB3|RSBN1|CCNB1|LAMC1|TACC3|SFPQ|KCTD9|PLK1|SPA17|MPHOSPH9|DUSP4|RNF4|CSPG4|BAG3|ARL6IP1|NET1|ARL4A|NCAPH|CDCA2|PRC1|KIF18A|CDC25C|FOXM1|CDCA3|FYN|CKS1B|MGAT2|CCNA2|MTMR6|CCSAP|STIL|NUP37|BIRC5|NEIL3|GOT1|PSMD11|FAM83D|OIP5|GAS2L3|TOP2A|NUSAP1|PKNOX1|BIRC3|KIF15|BCAR3|KIF20B|ANP32E|CIT|IQGAP3|CKAP5|TTK|SPAG5|GTSE1|NUP35|VANGL1|FZR1|CHEK2|KIF14|NDE1|ANXA3|UBE2S|KDM6A|DR1|ZNF207|LBR|CENPF|RACGAP1|SAPCD2|CKS2|FNBP4|CDC27|KIF2C|ESPL1|E2F5|BTG1|ATF7IP|CDCA8|MAT2A|ASPM|NEDD4L|WSB1|KATNA1|RDH11|SAP30|GPSM2|NUMB|BUB1|TSN|CNTROB|TNFRSF21|CCNB2|PCF11|RAD51C|KIF11|PSRC1|ECT2|CDC42EP4|KIF18B|CKAP2|ARHGAP19|METTL4|HJURP|MELK|UBE2D1|HMGCR|CTNND1|NDC80*	186	1.852	0.0612
REACTOME_G0_AND_EARLY_G1	*PCNA|RBL1|HDAC1|TOP2A|CCNE2|LIN54|DYRK1A|LIN37|CDK2|CCNA2|MAX|CDC6|E2F5|CDK1|RBBP4|TFDP1|RBL2|MYBL2|E2F4|E2F1|LIN9*	21	1.8516	0.0611

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
MYC_UP.V1_UP	*MNT|PUS3|CD320|HSPE1|TSSC4|KLF16|VPS9D1|TTYH2|MBLAC2|DDX10|WDR4|PRMT3|TOP1MT|C12ORF66|SLC19A1|SAC3D1|TMEM132B|NLE1|PUS7L|ISOC2|TMEM201|OAF|LAS1L|NOC4L|DIS3L|ITPR1|CCDC124|REPIN1|FARSB|NOP14|CDCA7L|PRR3|IPO4|SLC25A15|UNG|WDR43|RRP9|SLC25A26|ZNF667|PIGW|UBE3D|WDR83|TRNAU1AP|RPTOR|SMYD5|UTP14A|PUS7|C20ORF27|ANO2|ESF1|GPD1L|DCTPP1|MPHOSPH10|CAMKMT|UBIAD1|CD3EAP|NDUFAF4|USE1|ICAM5|EXOSC5|MRTO4|TMEM97|MMP16|CALML4|DPP7|MICU1|RPUSD4|C5ORF46|NOL6|TRMT1|GEMIN5|PES1|TFB2M|ZNF593|CHCHD10|MON1A|TSFM|AHSA1|TAF4B|HSPA6|EXOSC9|SLC25A22|AGPAT3|NR2C2AP|EEF1E1|TAF5|DPYSL5|ALG3|TGFBRAP1|METTL1|NIP7|AMPD2|SCFD2|QSOX2|ABCC4|CHKA|B3GNTL1|PCOLCE2|HSPBAP1|LHX6|PUS1|GLRX5|CGREF1|QTRT1|UTP15|RRP12|HS6ST2|MTFP1|PMM2|RRP15|RPP40|POLR1E|CAPS|SORD*	114	1.8514	0.0607
GO_RNA_METHYLATION	*LCMT2|MRM1|FBLL1|MEPCE|METTL16|WTAP|WDR4|RBM15B|METTL14|TARBP1|TRMT1|TRMT61B|NSUN4|TFB2M|THUMPD2|TYW3|FTSJ1|GTPBP3|TRMT13|TRMT10A|METTL3|TRMT11|THUMPD3|NSUN6|TFB1M|THADA|NSUN3|ZC3H13|TRMT112|CBLL1|DIMT1|METTL15|TRMT2A|METTL1|FBL|METTL2B|FTSJ3|METTL2A|NSUN2|PCIF1|TRMT61A|METTL6|TRDMT1|ZCCHC4|RNMT|TRMT6|TRMT1L|TGS1|TRMT5|EMG1|METTL8|HSD17B10|NOP2|RBM15|MTO1|NSUN5|ALKBH8|BCDIN3D|TRMT10C|RRNAD1*	60	1.8512	0.0603
GO_NUCLEAR_CHROMOSOME_SEGREGATION	*BUB1B|CHMP1A|NEK2|PHF23|TTN|ANAPC1|RIOK2|EME1|TNKS|NCAPH2|CCNE2|CDC42|CDCA5|TTL|TEX14|UBE2B|FEN1|TUBG1|DDX12P|XRCC3|NEK6|HIRA|MAD1L1|CDC23|CUL3|CDC20|MAD2L2|CTCF|FBXO5|BOD1|CENPQ|MUS81|AKAP8|NAA50|PTTG1|ZWINT|AURKB|DIS3L2|SMC5|KIF4A|NIPBL|CDC6|MSTO1|MCMBP|ATRX|VPS4B|NAA10|MAD2L1|KIF22|SPICE1|CENPE|RAN|DSN1|SMC4|EME2|CHMP4A|PDS5A|CHMP6|SMC1A|SEH1L|SMC3|NUF2|GEM|ANAPC4|TRAPPC12|RAD21|KPNB1|KIFC1|NSL1|CDC26|TRIP13|TPR|CENPK|KATNB1|RMI2|TERF1|PINX1|KIF23|BUB3|MLH3|AKAP8L|CCNB1|CHMP4B|DYNC1H1|TACC3|SFPQ|PLK1|ANAPC11|NCAPD2|SPDL1|PPP2R1A|PSMG2|RAB11A|DLGAP5|RCC2|DYNC1LI1|CDK5RAP2|HECW2|RMI1|NSMCE2|NCAPH|HNRNPU|CHMP7|ACTR3|KIF18A|PRC1|INO80|CDT1|PHF13|PIBF1|RRS1|ACTR2|ATM|FMN2|STAG3|FANCD2|CHMP2B|CHMP1B|FAM83D|ZW10|MLH1|LCMT1|NUMA1|KIF4B|TOP2A|NUSAP1|CTNNB1|SMC1B|RB1|C14ORF39|TTK|SMC2|SPAG5|DDX11|ANAPC5|BRIP1|KIF14|PDS5B|LATS1|INCENP|CHTF8|ZNF207|ESCO2|PCID2|CENPF|MAU2|RACGAP1|HDAC8|MIS12|BAG6|KLHL22|SLX4|CDC27|KIF2C|NCAPD3|ESPL1|NUP62|CDCA8|VPS4A|STAG2|STAG1|PHB2|SIRT2|BUB1|TOP2B|GEN1|POGZ|CHAMP1|RAD51C|CHMP5|ESCO1|PSRC1|ECT2|KIF18B|NCAPG|SUN1|APC|ERCC4|CHMP2A|BECN1|DSCC1|IK|NDC80*	183	1.8489	0.0615
WHITFIELD_CELL_CYCLE_LITERATURE	*BUB1B|CDKN1A|AURKA|CDC25C|TYMS|CCNE2|MCM2|BRCA2|CENPF|RACGAP1|CKS2|CCNA2|E2F5|NASP|KIF20A|BIRC5|PCNA|CDC20|RRM1|NPAT|CDC45|BUB1|TOP2A|CCNB1|SLBP|PLK1|CCNB2|MCM6|CDC25B|CDC6|CDKN3|CDK1|RRM2|BRCA1|MSH2|CCNG2|CCNF|E2F1*	38	1.843	0.0648
GO_REGULATION_OF_HISTONE_H3_K4_METHYLATION	*DNMT1|RTF1|ZNF335|WDR61|SNW1|PRMT6|DNMT3B|PAXIP1|CTNNB1|BCOR|KDM1A|AUTS2|SMAD4|PIH1D1|BRCA1|CTR9|PYGO2*	17	1.8382	0.0681

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
GO_REGULATION_OF_CHROMATIN_ORGANIZATION	*ZNF335|MTF2|MAPK8|TLK1|CHEK1|PHF2|UBE2B|PRKD1|MAPK3|HIRA|C6ORF89|MPHOSPH8|SKI|MKI67|CTCF|ASF1A|PADI2|PRMT6|AKAP8|MECP2|PAXIP1|SIRT1|ING2|NAA40|NIPBL|SMAD4|ZBTB7B|PIH1D1|SET|BRCA1|TAF7|SETD7|ATRX|FLCN|NSD1|SPHK2|ZMPSTE24|PHF8|MLLT6|TP53|JDP2|RNF40|MAP1S|PRKD2|LRRK2|TPR|PYGO2|ATAD2|LMNA|DNMT1|RIF1|SUPT6H|TADA2B|HMGA1|WBP2|SREBF1|AKAP8L|CCNB1|KPNA7|TRIM28|EED|SIRT6|SMARCB1|UBR5|RNF20|WDR70|PARP10|SIN3A|HNRNPU|ZNHIT1|SNAI2|DNMT3B|PPHLN1|TLK2|ALKBH4|TADA3|SART3|KDM5A|ATM|ARRB1|SETD5|CAMK2D|FMR1|MORC2|BRD7|GLYR1|CDC45|ZNF274|WDR61|NOC2L|ATG5|RPS6KA4|CTNNB1|MTHFR|ZNF451|ATAD2B|AUTS2|CTBP1|CTR9|SPTY2D1|IWS1|OTUB1|RTF1|TADA2A|KDM4D|SNW1|PHF1|KAT7|TRIP12|PAF1|BCOR|ATF7IP|CHTOP|KDM3A|PIWIL2|SETDB1|MIER1|OGT|KAT2A|RPS6KA5|UBE2N|SETD1A|KDM1A|PHF19|METTL4|CDK9|RUVBL2|KDM4C|BRD4*	129	1.8379	0.0677
GO_RIBOSOMAL_LARGE_SUBUNIT_BIOGENESIS	*RPL14|URB1|PAK1IP1|BRIX1|HEATR3|MALSU1|NOP16|RRS1|PES1|RPL3L|EBNA1BP2|NLE1|GTPBP4|RPL10A|RPL26|DDX28|RSL24D1|SDAD1|WDR74|ZNHIT3|RPL7L1|GTF3A|RPL7A|NPM1|RPL35|NVL|RPF2|LAS1L|NOC2L|NOL9|MRPL11|DHX30|RPL6|RPL3|RPL35A|WDR12|RSL1D1|NIP7|RPL11|RPL10|FTSJ3|RPL7|RPL12|MDN1|FASTKD2|DDX18|RPLP0|BOP1|RPL5|ZNF622|MRPL20|NHP2|NOP2|SURF6|RPL26L1|MRTO4|ZNHIT6|RPL23A|MRPL1|EIF6|RPL24|RPL38*	62	1.8368	0.068
GO_PROTEIN_LOCALIZATION_TO_MICROTUBULE_ORGANIZING_CENTER	*BBS4|AURKA|CEP192|UBXN2B|GSK3B|PIBF1|PCM1|GOLGB1|NUP62|DISC1|BICD1|CEP250|CCDC14|C2CD3|STIL|CSNK1D|HOOK3|NUMA1|DCTN2|MARK4|NSFL1C|NUDCD3|KIAA0753|NEDD1|CEP72|SPAG5|APC*	27	1.8349	0.0688

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
GO_MRNA_PROCESSING	*HNRNPH2|ZMAT5|APP|ALKBH5|SNRPB2|ZRSR2|MNAT1|THOC1|SNUPN|FXR2|PAPOLG|C9ORF78|LUC7L3|RALY|RBMXL1|SNRPD1|HNRNPR|PCBP1|REST|XRN2|RBM28|HNRNPH1|SARNP|KIN|SNRNP25|POLR2C|SNRPD3|HNRNPA2B1|NOVA2|SREK1|NUP98|GRSF1|SLTM|TIA1|WDR83|GEMIN7|SAFB2|ARL6IP4|RSRC1|TFIP11|RNMT|PRPF4B|JMJD6|ZNF326|WDR33|CELF2|TGS1|RBM26|RBM23|SSU72|SFPQ|MTPAP|POLR2K|NOL3|SRSF4|RPRD1B|HABP4|PRPF39|CWC25|NSRP1|DHX8|RBMX|SART3|DHX36|RBM15B|SF3B4|U2SURP|CD2BP2|SNRNP35|GEMIN6|PRPF3|WBP11|UPF3B|WDR77|CWF19L1|TRA2B|RNPS1|SF3B3|MBNL1|DHX15|ADARB2|SNRNP40|PUF60|TSEN34|RBFOX2|IWS1|CDK11A|CDK11B|SAFB|RPRD2|RPRD1A|SNW1|PPWD1|ELAVL1|PRKRIP1|AAR2|TSEN2|CHTOP|HSPA8|FAM172A|FASTKD5|POLR2I|SMNDC1|SLBP|PCF11|BUD31|KDM1A|ZBTB7A|HTATSF1|GTF2F1|SRSF8|NONO|PAPOLA|PRDX6|METTL16|SCAF11|PCBP2|METTL14|PAN2|HNRNPUL1|SON|CDK7|SRSF9|SF3A3|SF3B1|PPIL3|PPIH|NOVA1|GTF2H1|ZC3H13|POLR2A|PTBP2|SF3A1|POLDIP3|ERCC3|HNRNPD|NCBP1|SF1|CTNNBL1|PHF5A|SNRPG|CSTF1|KHSRP|YTHDC1|RBM38|RNF40|POLR2F|GPATCH1|RPUSD3|SNRNP27|RBM10|SNRPA|DDX20|COIL|SMU1|DHX40|CCNB1|RRP1B|ZCCHC8|CDC5L|NCL|SUPT5H|HNRNPL|RNF20|ZC3H3|USP39|LUC7L2|RBM5|DDX5|POLR2D|CPSF7|LSM11|MBNL3|PHRF1|FMR1|SNRPF|TUT1|RBM22|SRRM1|SF3B5|PRPF18|SYMPK|TRA2A|POLR2L|RBM8A|CHERP|CSTF3|RBM42|PRMT7|CWC15|SCAF1|DYRK1A|SNRPB|CRNKL1|CLNS1A|TSEN15|PPIE|SRSF11|SREK1IP1|HNRNPA1|POLR2E|POLR2J|DAZAP1|THOC6|RNPC3|RBM19|CPSF3|CSTF2T|CPSF1|DDX17|PNPT1|CWC27|CPSF2|RBMX2|CDK13|DDX23|DHX35|CCAR1|DDX46|AURKAIP1|BRDT|CDC40|LSM10|PAN3|PRPF6|PTBP1|BUD13|RNASEL|CWF19L2|CIRBP|LSM2|ZFP36L1|GTF2F2|HNRNPA0|SNRNP70|U2AF2|TSEN54|PRPF40B|CELF1|SRSF6|SFSWAP|CPSF6|TRUB2|SRSF1|SART1|SRSF2|TTF2|PRPF8|RNF113A|FIP1L1|RBM15|YBX1|FXR1|LSM1|POLR2H|SRPK1|PLRG1|ALYREF|XAB2|SRSF12|USP4|PPP1R8|QKI|PRPF38A|CLP1|PPP4R2|TBRG4|LUC7L|SCAF8|RBM3|PRPF19|PTCD2|DDX42|PRKACA|PSIP1|NPM1|THRAP3|DCPS|LEO1|GTF2H4|RBM27|DDX39B|PQBP1|PPIL1|EIF4A3|METTL3|THOC3|DDX47|SYF2|AQR|CTR9|STRAP|SRSF5|DHX38|PRCC|TXNL4B|CDK12|GCFC2|ADARB1|LSM4|CDK9|SNRPD2|IK|AHCYL1|SNRPC|WTAP|GEMIN2|CASC3|ZC3H11A|CLASRP|DNAJC8|SUGP2|ADAR|FRG1|SRRT|SRPK2|POLR2B|MFAP1|PABPN1|RBM4|KHDRBS1|TARDBP|SF3B2|SF3A2|TXNL4A|SNRNP200|SNIP1|SRSF3|SNRPA1|LSM5|FUS|GEMIN8|DHX9|ERCC2|DDX39A|HNRNPF|PTBP3|THOC7|DDX1|ZMAT2|GTF2H3|SRRM2|HNRNPK|SUPT6H|LGALS3|CCNT1|PDCD7|DHX16|CIR1|SETX|LSM3|MAGOH|AKAP8L|RBM39|THOC2|RBM7|RBM4B|PDE12|SAP18|HNRNPC|CWC22|WBP4|HNRNPU|LSM6|ZRANB2|POLR2G|ECD|PRPF31|ERN1|GEMIN5|PRMT5|SUGP1|ACIN1|NCBP2|RNGTT|SNRPE|PRPF40A|LSM7|BARD1|UBL5|PDCD11|CNOT6L|SLU7|PRPF38B|CACTIN|PNN|HNRNPA3|PAF1|ZCRB1|AKAP17A|PABPC1|HNRNPH3|KHDRBS3|CSTF2|DBR1|THOC5|SNRNP48|PRPF4|ZNF830|NUDT21|HSF1|GEMIN4|GPKOW|DDX41|CCNH|RBM25|EFTUD2|HNRNPM|RBBP6|SYNCRIP|RBM17|SRSF7|ZC3H10|C1QBP|CPSF4|BCAS2|CDC73*	417	1.8343	0.0687
GO_NEGATIVE_REGULATION_OF_NUCLEAR_DIVISION	*BUB1B|MAD2L1|MTBP|TNKS|ZNF207|CHEK1|PCID2|TOM1L2|AURKAIP1|CDT1|CENPF|TEX14|KLHL22|RAD21|ATM|BMP7|XRCC3|RAD1|MAD1L1|TRIP13|PRKAR1A|TPR|MAD2L2|CDC20|ZW10|FBXO5|LCMT1|BUB1|GEN1|BUB3|PTTG1|CCNB1|AURKB|PLK1|SPDL1|PSMG2|NME6|TTK|DYNC1LI1|CDK5RAP2|APC|IK|ATRX|NAA10|NDC80*	45	1.8314	0.0702

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
TONKS_TARGETS_OF_RUNX1_RUNX1T1_FUSION_MONOCYTE_UP	*IFRD2|HSPE1|HSPB1|IFI44|OAS1|RAB13|HSPD1|UCHL1|TNPO2|PFKM|NME1|GATAD2A|ECHS1|FAM136A|MYOF|IFIT1|MRPS35|CKB|TEX2|PWP1|DUSP14|TP53I3|CTPS1|TM4SF1|MT2A|NOP14|HERC5|RHOBTB1|UNG|SNRPA1|WDR43|CCND2|MRPL17|RRP9|TRIB3|DKC1|ARAP3|SLIRP|SEH1L|PPFIBP1|PLS3|PLTP|ANKRD40|MDH2|KHSRP|KANK2|PXDN|BZW2|AK2|C11ORF95|DLAT|TRIP13|POLE2|ESF1|HSPA5|NOLC1|PPME1|DAG1|NOP56|TMEM158|NHP2|ST6GAL1|HOMER1|GCSH|SFXN1|SOX4|SLC20A1|MT1X|ARL4A|CALU|SIVA1|CDC123|LPL|MTX1|NR2F6|GDF15|PPP1R14B|GBP1|TCP1|EIF3B|UBA5|L1CAM|PES1|EBNA1BP2|TFPI|FASTKD1|GTPBP4|CH25H|GPS2|NCLN|RAD54L2|ISG15|FERMT2|NPM1|FGFR1|TRIP6|SPTAN1|UXS1|ATP1B3|PFKP|DUSP6|GLRX3|SMARCA4|NES|PSMD12|LIMS1|APOE|DNAAF2|FARP1|AMPD2|EXT1|GOSR2|TUBB6|PSMB5|GSPT1|ECI2|RMND5A|PTDSS2|SLC9A1|EPS8|ARHGEF12|HOMER3|PUS1|SLC5A3|MYBBP1A|DDR1|DDX18|GFOD1|PA2G4|JAM3|MREG|SPATS2L|TNPO1|EIF4EBP1|TCF7L2|CTDSPL|ALDH1A2|NAP1L1|SLC39A7|UBE2J1|NDUFAB1|FABP3|APLP2|TUBB2A|FLNB|EHD2|SLC16A1|C1QBP|TRMU|SORD|SASH1|DDX24|KCNN4*	153	1.8265	0.0737
GO_PROTEIN_DNA_COMPLEX_DISASSEMBLY	*SMARCE1|HMGA1|SMARCD1|RPL23|SMARCC1|SMARCC2|SMARCD3|ARID2|GRWD1|SMARCB1|PBRM1|SMARCA4|SMARCD2|SET|SUPT16H|ARID1A*	16	1.8259	0.0736
BURTON_ADIPOGENESIS_12	*TMEM68|SRPK2|MKI67|ARGLU1|MYEF2|BUB1|GTF2A1|BOD1L1|FAM76B|UBE2V2|CASP8AP2|SP3|HNRNPM|PTBP3|NIPBL|CAPN7|PHF12|DNAJC3|KIF2A|ZNF638|ARID1A|IMPAD1|EMC2|IREB2*	24	1.8228	0.0754
GO_REGULATION_OF_HISTONE_H3_K9_METHYLATION	*LMNA|DNMT1|RIF1|KDM4D|ZNF274|DNMT3B|MECP2|SIRT1|KDM1A|SMARCB1|PIH1D1|BRCA1|KDM3A|KDM4C|SETD7|ATRX*	16	1.8221	0.0754
VANTVEER_BREAST_CANCER_BRCA1_UP	*PACSIN3|GLIPR2|KDM2B|SERBP1|MTF2|JAGN1|VRK2|RRP1|EML4|SLC30A7|REXO2|RTCA|GLMN|TRIP6|RRP1B|UCHL5|FOXN2|SLC11A2|PPP1CB|DNTTIP2|DENND1B|OGG1|KCNN4|WDR43|ATAD3A|EEF1D*	26	1.822	0.0749
GARGALOVIC_RESPONSE_TO_OXIDIZED_PHOSPHOLIPIDS_TURQUOISE_DN	*BUB1B|OSGEPL1|ARMCX4|PRMT7|E2F8|AURKA|NR2F6|SKP2|SPC24|CCNA2|ENOSF1|RRS1|PPP1R35|ESPL1|ZNF174|GEMIN6|CBX2|PAGR1|KIFC1|DDX28|CCDC51|NIF3L1|DHRS3|FAM111A|CDC20|NEIL3|MKI67|TREX1|NXF1|PML|TMPO|ZNF280D|EXOSC2|FAM111B|ZNF93|POLR3B|KIF15|TACC3|PLK1|TTLL12|PPIL2|BARD1|CCNF|ELOVL6|NDC80*	45	1.8147	0.0803
GO_CHROMOSOME_SEGREGATION	*RECQL5|CHMP1A|ARL8A|TTN|EME1|TNKS|ARL8B|RIOK3|TLK1|CDCA5|TTL|MIS18A|DDX3X|TEX14|CENPT|FEN1|TUBG1|XRCC3|NEK6|CUL3|CDC20|CTCF|AKAP8|NAA50|PTTG1|DIS3L2|SKA1|SMC5|ATRX|MAD2L1|KIF22|CENPE|RAD18|RAN|DSN1|EME2|SEH1L|ANAPC4|SKA3|RAD21|KPNB1|NSL1|TPR|CENPK|PINX1|MLH3|TACC3|CSNK2A2|SFPQ|CSNK2A1|PLK1|ANAPC11|SPDL1|PPP2R1A|DLGAP5|RCC2|DYNC1LI1|CDK5RAP2|SRPK1|HECW2|CHMP7|KIF18A|PRC1|INO80|SKA2|CDT1|RRS1|ATM|FMN2|STAG3|FAM83D|ZW10|OIP5|LCMT1|NUMA1|NUSAP1|CTNNB1|C14ORF39|SMC2|PUM1|PDS5B|INCENP|ZNF207|PCID2|CENPN|MIS12|SLX4|KIF2C|NCAPD3|ESPL1|CDCA8|STAG2|STAG1|RPS3|NDEL1|CHMP5|PSRC1|KIF18B|NCAPG|SUN1|APC|HJURP|ERCC4|BECN1|IK|TOP3A|NDC80|BUB1B|NEK2|PHF23|ANAPC1|RIOK2|NCAPH2|CCNE2|CDC42|UBE2B|SPC25|DDX12P|TOP1|HIRA|MAD1L1|CDC23|MAD2L2|MKI67|FBXO5|BOD1|CENPQ|MUS81|ZWINT|AURKB|NUP43|PUM2|KIF4A|NIPBL|CDC6|BANF1|MSTO1|BRCA1|NR3C1|MCMBP|VPS4B|NAA10|SPICE1|SMC4|CHMP4A|ERCC2|PDS5A|CHMP6|SMC1A|SMC3|NUF2|GEM|TRAPPC12|SMARCAD1|KIFC1|TOP3B|CDC26|TRIP13|SLC25A5|KATNB1|RMI2|TERF1|KIF23|BUB3|AKAP8L|CCNB1|CHMP4B|DYNC1H1|RCC1|MMS19|NCAPD2|NTMT1|CIAO1|PSMG2|RAB11A|RMI1|NSMCE2|NCAPH|UVRAG|HNRNPU|ACTR3|CDCA2|TLK2|PHF13|PIBF1|ACTR2|NUP37|FANCD2|BIRC5|CHMP2B|CHMP1B|MLH1|KIF4B|TOP2A|SMC1B|RB1|TTK|SPAG5|DDX11|ANAPC5|BRIP1|KIF14|NDE1|LATS1|CHTF8|ESCO2|CENPF|MAU2|RACGAP1|HDAC8|UBE2I|BAG6|KLHL22|CDC27|NUP62|SMC6|VPS4A|PHB2|SIRT2|BUB1|TOP2B|GEN1|POGZ|CHAMP1|USP9X|RAD51C|ESCO1|ECT2|CENPW|CHMP2A|DSCC1|CEP85*	232	1.8112	0.0826

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
REACTOME_BASE_EXCISION_REPAIR	*MUTYH|TINF2|RPA1|APEX1|PARP1|XRCC1|MPG|RFC5|MBD4|TDG|FEN1|RPA2|NTHL1|RFC2|TERF2|POLE4|POLE2|RPA3|RFC1|PCNA|NEIL3|LIG3|TERF2IP|POLD3|ADPRHL2|POLD1|TERF1|RFC3|PARP2|POLB|LIG1|POLD2|POLE|POLE3|PNKP|OGG1|POT1|UNG|NEIL2|RFC4|SMUG1*	41	1.8109	0.0822
GO_NEGATIVE_REGULATION_OF_GENE_EXPRESSION_EPIGENETIC	*SIN3A|RBBP7|MTF2|DNMT3B|PPHLN1|PCGF1|NRDE2|HMGB1|PHF2|UBE2B|MORF4L1|HAT1|MBD1|MORF4L2|RBBP4|HIRA|MPHOSPH8|ARID1A|ASF1A|SMARCA5|MORC2|DNMT3A|CDC45|MECP2|HDAC5|SIRT1|HDAC2|EZH2|NAA40|EZH1|ATAD2B|POLE3|CTBP1|PCGF2|HDAC1|BEND3|PHF8|PHF1|CREBZF|BAZ2A|LHX2|SMCHD1|AEBP2|EPC1|SUZ12|PPM1D|ATF7IP|FAM172A|MBD3|MSL3P1|RRP8|SUV39H1|ATAD2|ZNFX1|SETDB1|DNMT1|RIF1|SIRT2|TRIM27|HMGA1|UBR2|MIER1|HELLS|TRIM28|EED|DOT1L|PHF19|SIRT6|MSL3|MBD2*	70	1.8106	0.0818
GO_METHYLATION	*RAB6A|CARM1|ZNF335|MTF2|MIS18A|WDR4|COQ5|DMAP1|TARBP1|WDR5|EHMT2|WDR82|GATAD2A|PCMT1|MPHOSPH8|THUMPD2|CTCF|PWP1|ASMTL|GSTO1|GSK3A|PRMT6|MECP2|SIRT1|COQ3|TDRD5|TRMT10A|SUV39H2|SNRPD3|NSUN6|SMYD4|SMAD4|ICMT|THADA|NSUN3|ATRX|ZMPSTE24|MLLT6|METTL2B|FTSJ3|METTL2A|CXXC1|PRMT2|SMYD5|METTL6|PAGR1|RLF|RNMT|FAM98A|NDUFAF5|METTL7A|PRMT1|PYGO2|LMNA|RIF1|TGS1|ETF1|CAMKMT|RBM15|PRDM10|TET2|MTO1|EED|AS3MT|SMYD2|BCDIN3D|GCSH|SMARCB1|GNAS|MBD2|RRNAD1|DNMT3B|RBBP5|RBM15B|TRMT61B|NSUN4|PIK3CA|TPMT|SETD5|CIAPIN1|MEN1|METTL7B|COPRS|ZNF274|LCMT1|GTPBP3|CTNNB1|METTL3|MTHFR|TTLL12|SETD6|TFB1M|SETD3|CTR9|DIMT1|IWS1|METTL17|METTL1|FBL|SNW1|GSPT1|KDM6A|BAZ2A|NSUN2|AHCY|BCOR|PPM1D|TRMT61A|CHTOP|ZCCHC4|TRMT1L|GAMT|OGT|METTL8|NOP2|SETD1A|KDM1A|ALKBH8|METTL4|TRMT10C|KDM4C|LCMT2|PRDM2|RAB3D|MEPCE|METTL16|WTAP|PRMT3|METTL14|PEMT|MTRR|MTR|SETMAR|FTSJ1|PICK1|DDX4|PAXIP1|EZH2|DPH5|ASH2L|PIH1D1|BRCA1|ZC3H13|CBLL1|SETD2|SETD7|FBXO11|HNMT|METTL15|NSD1|TYMS|PARP1|N6AMT1|PCIF1|SUZ12|TRDMT1|MBD3|NDUFAF7|TRMT6|SUV39H1|DNMT1|SETD1B|SUPT6H|MECOM|KPNA7|TRIM28|NSUN5|NTMT1|DOT1L|RNF20|MRM1|FBLL1|TRMT1|PRMT5|SMYD3|TFB2M|MTA2|TYW3|EHMT1|PCMTD1|DNMT3A|WDR61|MAT2B|TRMT13|SETD9|TRMT11|THUMPD3|PRDM15|EZH1|AUTS2|METTL18|TRMT112|MGMT|TRMT2A|PRMT7|RTF1|PCMTD2|KDM4D|BEND3|PHF1|PAF1|COMT|SNRPB|ARID4B|ARID4A|ATF7IP|TDRKH|KDM3A|RRP8|MAT2A|PIWIL2|SETDB1|KDM1B|TRMT5|EMG1|METTL21A|HSD17B10|METTL5|PHF19|ASH1L|RAB3B|BRD4|FAM98B|BHMT*	224	1.8091	0.0824
GO_POSITIVE_REGULATION_OF_CELLULAR_RESPONSE_TO_TRANSFORMING_GROWTH_FACTOR_BETA_STIMULUS	*GOT1|SDCBP|FLCN|TGFBR3|SNW1|ING2|THBS1|HSP90AB1|ADAM17|CDKN1C|CREBBP|TGFB1I1|NPNT|RNF111|STK11|SMAD4|EP300|GIPC1|FERMT1|MEN1*	20	1.8074	0.0834
WILCOX_RESPONSE_TO_PROGESTERONE_UP	*LSS|MTF2|PRC1|IDH1|IDI1|CYB5B|ETV1|KIAA0895|HMMR|DHCR7|TNFAIP6|CDKN2AIP|NSDHL|NUP160|PBK|HMGCS1|LARP4|HBP1|SAMD9|HBB|CDC20|ORC4|HBD|CENPQ|TOP2A|MVK|NUSAP1|XRCC4|HMOX1|GK|KIF4A|SHMT1|CDC6|CDK1|CEP55|RRM2|SMC2|HSD17B11|DNAAF2|LGALS8|MON2|HMGN3|WDHD1|FDPS|DNAJB9|C7ORF25|TYMS|PDS5A|TDO2|ACAT2|CENPN|CENPF|IFT74|ATG2B|KLHL24|EBP|SCD|PEG10|KIF20A|FDFT1|METTL7A|LDLR|ASPM|GALK2|RIF1|MSMO1|PPL|FADS2|TTF2|HMGB2|TTC30A|CEP57|FADS1|SHCBP1|LPIN1|CCNB1|SMPDL3A|MDM1|CCNB2|DLGAP5|NCAPG|HBS1L|TMEM97|HJURP|CYP51A1|IFNAR2|HMGCR|SUMO1|CEP76|BBS7|YTHDC2|TK1|ELOVL6|SEC14L1|FANCI|NDC80*	96	1.8069	0.0831
GO_NEGATIVE_REGULATION_OF_CHROMOSOME_SEGREGATION	*MAD2L1|BUB1B|TNKS|ZNF207|PCID2|CENPF|CDT1|TEX14|KLHL22|RAD21|ATM|ESPL1|XRCC3|MAD1L1|TRIP13|TPR|MAD2L2|CDC20|ZW10|FBXO5|LCMT1|BUB1|GEN1|BUB3|CCNB1|PTTG1|PLK1|AURKB|SPDL1|PSMG2|TTK|DYNC1LI1|CDK5RAP2|APC|IK|ATRX|NDC80|NAA10*	38	1.8063	0.083

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
REACTOME_MITOCHONDRIAL_TRNA_AMINOACYLATION	*MARS2|EARS2|TARS2|DARS2|PARS2|CARS2|VARS2|YARS2|HARS2|RARS2|IARS2|NARS2|LARS2|PPA2|AARS2|SARS2|WARS2|FARS2*	18	1.803	0.0856
GO_SNRNA_3_END_PROCESSING	*EXOSC6|INTS1|EXOSC4|TOE1|EXOSC2|INTS2|EXOSC7|EXOSC8|INTS8|INTS6|INTS7|EXOSC9|EXOSC3|EXOSC5|USB1|INTS5|INTS12*	17	1.8015	0.0862
GO_VIRAL_RNA_GENOME_REPLICATION	*APOBEC3B|SETDB1|FMR1|MORC2|TOP2B|TOP2A|CDC42|ATG5|ROCK2|TRIM28|EEA1|PCBP2|ATG16L1|PI4KA|INPP5K|PIK3C2G|SMARCB1|RAB5A|MPHOSPH8|PCBP1|APOBEC3G*	21	1.8004	0.0865
GO_REGULATION_OF_CHROMOSOME_SEPARATION	*BUB1B|ANAPC1|RIOK2|CDT1|TEX14|ATM|XRCC3|NEK6|MAD1L1|CDC23|MAD2L2|CUL3|CDC20|ZW10|FBXO5|LCMT1|NUMA1|PTTG1|AURKB|RB1|CDC6|TTK|ANAPC5|MAD2L1|CENPE|ZNF207|PCID2|CENPF|ANAPC4|KLHL22|CDC27|RAD21|ESPL1|CDC26|TRIP13|TPR|BUB1|GEN1|BUB3|CCNB1|TACC3|CSNK2A2|CSNK2A1|PLK1|ANAPC11|SPDL1|PSMG2|DLGAP5|DYNC1LI1|CDK5RAP2|APC|HECW2|IK|NDC80|NSMCE2*	55	1.8003	0.0859
PUJANA_XPRSS_INT_NETWORK	*NFYB|GINS1|MTF2|RAD51AP1|SKP2|CD47|EXOSC8|DDX46|HMMR|AATF|ABCB7|SPC25|TOP1|RBBP4|TFDP1|FRG1|ZNHIT3|CDC20|POLA1|MKI67|RRM1|ASF1A|CTCF|POLR2B|RFC3|METAP1|PAXIP1|ZWINT|STMN1|EZH2|AURKB|PPP2R5C|CHAF1A|CDK1|SEC31A|BRCA1|RBBP8|CCNF|SRSF3|UNG|SNRPA1|BLM|MYBL2|MAD2L1|DUT|ILF3|EIF3H|CNOT3|SMC4|MCM5|AURKA|RPA1|SMC1A|DDX39A|CASP2|SMC3|TOPBP1|MCM2|TAF11|DNAJC9|MCM4|HMGN4|SUZ12|PRKDC|RAD21|TIMELESS|KIFC1|NASP|UBE2C|TCF3|PCNA|RIF1|DNMT1|COPS3|DEK|SNRPA|TTF2|DCP2|TMPO|HMGB2|CNTRL|BUB3|NFATC2IP|KNTC1|LMNB1|CSNK2A1|NCAPD2|MPHOSPH9|MCM6|MSH2|RECQL|RFC4|FANCI|BLMH|FOXM1|SLC7A1|NAE1|CCNA2|ATM|CDC7|ZNF131|USP1|RAD54L|ZNF330|PSIP1|TOP2A|PRPS1|DDX39B|RNASEH2B|KIF20B|ANP32E|RB1|SMC2|GTSE1|PPP1CC|FUBP1|CHEK2|PNN|UBE2S|DNA2|ACYP1|LBR|BRCA2|TBCA|SNRPB|PRPF4|ATP11B|ESPL1|MAT2A|PAICS|KATNA1|SRSF11|SSBP2|CEP57|TCERG1|LARP7|HMGN1|POLE|CAD|RAD51C|IDH3B|XPO1|NCK1|CPSF4|NDC80*	145	1.7968	0.0884
GO_POSITIVE_REGULATION_OF_TRANSCRIPTION_BY_RNA_POLYMERASE_I	*UTP15|PWP1|PHF8|HEATR1|MTOR|TAF1|NOL11|NCL|EIF2AK3|WDR75|DHX33|IPPK|SMARCB1|UBTF|PIH1D1|SMARCA4|DDX11|ERBB2|WDR43*	19	1.7965	0.0881
WANG_METASTASIS_OF_BREAST_CANCER_ESR1_UP	*ATAD2|PSMC2|KPNA2|SMC4|CCNE2|UCKL1|ZCCHC8|PLK1|FEN1|EEF1A2|SUPT16H|GTSE1|NCAPG2|PPP1CC|YIF1A*	15	1.7957	0.0883
SMITH_LIVER_CANCER	*FDPS|GSTA4|AURKA|PMVK|IMPA2|RAB4A|CENPF|SEMA5A|SDHC|COPS5|ACACA|PIR|ANXA7|CHPT1|PAK4|TMEM106C|TOP2A|GSTM4|NHP2|PEX2|TOB1|IFT20|TNFAIP3|RHOBTB3|BNIP3|NCOA2|TBCE|PDCD5|PFDN6|CDKN3|HJURP|PPP2R5A|ADIPOR1|TP53BP2|PGRMC1|MTFR1|ALDH1A1*	37	1.7954	0.0879
GENTILE_UV_RESPONSE_CLUSTER_D4	*SAMD4A|UFL1|ARF6|AURKA|PDCD10|RBM5|FZD7|DDX3X|UBE2G1|RAD21|ZFP36|ARID5B|BMPR1A|ATP2A2|USP1|THUMPD1|CHSY1|PHC2|SMURF2|CLINT1|SEC24B|HMGB2|KPNA2|TPST1|SIAH1|CCNB1|POGZ|USP10|DICER1|KANK1|UAP1|RAB1A|SNRNP40|PPP2R5C|XPO1|SLC20A2|SPEN|GNE|DDX17|FILIP1L|KRIT1|EEF1E1|RAPGEF2|PUM1*	44	1.7945	0.088
PID_PLK1_PATHWAY	*BUB1B|TPT1|WEE1|CENPE|AURKA|CDC25C|INCENP|PRC1|ROCK2|TPX2|SPC24|NUDC|GORASP1|TUBG1|PPP2CA|STAG2|KIF20A|PAK1|CDC20|PPP1R12A|FBXO5|BUB1|CCNB1|CLSPN|PLK1|PPP2R1A|ODF2|RHOA|RAB1A|CDC25B|PPP1CB|ECT2|CDK1|ERCC6L|KIF2A|GOLGA2|FZR1|FBXW11|NDC80*	39	1.7941	0.0879

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
GO_REGULATION_OF_CHROMOSOME_ORGANIZATION	*UPF1|MAP3K4|GNL3L|ZNF335|MTF2|TINF2|MAPKAPK5|TNKS|MAPK8|TLK1|MNAT1|CHEK1|CDCA5|YLPM1|PARN|TEX14|FEN1|PRKD1|MAPK3|XRCC3|NEK6|C6ORF89|MPHOSPH8|SKI|CUL3|CDC20|CTCF|ASF1A|SENP6|PRMT6|AKAP8|MECP2|SIRT1|ING2|PTTG1|SMG6|NBN|SMC5|HNRNPA2B1|MAP2K7|SMAD4|ZBTB7B|SET|TAF7|ATRX|MAD2L1|CENPE|ZMPSTE24|MLLT6|PPP1R10|RTEL1|TP53|ANAPC4|JDP2|RAD21|LRRK2|TPR|PYGO2|LMNA|RIF1|TADA2B|HMGA1|WBP2|SREBF1|PINX1|TACC3|SFPQ|CENPV|PLK1|ANAPC11|EED|SPDL1|SMARCB1|DLGAP5|DYNC1LI1|CDK5RAP2|PNKP|RNF4|HECW2|HMBOX1|UBR5|WDR70|SIN3A|ZNHIT1|DNMT3B|ALKBH4|SART3|TCP1|CDT1|DHX36|CTC1|LIG4|KDM5A|ATM|SETD5|CAMK2D|GLYR1|ZW10|ZNF274|LCMT1|EXOSC10|NUMA1|NOC2L|ATG5|CTNNB1|ERCC1|MTHFR|MAPK1|SMG7|ZNF451|POT1|CTR9|SPTY2D1|IWS1|TADA2A|SNW1|ZNF207|PCID2|CCT5|XRCC1|BCOR|SLX4|ESPL1|CHTOP|XRCC5|OGT|KAT2A|NEK7|RPS6KA5|SETD1A|KDM1A|PKIB|APC|METTL4|CDK9|ERCC4|KDM4C|BECN1|IK|NDC80|BUB1B|NEK2|ANAPC1|RIOK2|PHF2|UBE2B|HIRA|TERF2|MAD1L1|SMG5|CDC23|SETMAR|MAD2L2|MKI67|GNL3|PADI2|FBXO5|PML|ATR|CCT6A|PAXIP1|AURKB|MAPT|FBXO4|NAA40|NIPBL|NABP2|CDC6|PIH1D1|BRCA1|NAF1|SETD7|NAA10|HNRNPD|FLCN|NSD1|SPHK2|DKC1|PHF8|PARP1|MCM2|TRAPPC12|RNF40|MAP1S|CDC26|TRIP13|PRKD2|CCT7|ATAD2|DNMT1|SUPT6H|RMI2|DCP2|TERF1|BUB3|AKAP8L|CCNB1|KPNA7|TRIM28|CCT3|SIRT6|PSMG2|USP7|RNF20|PARP10|NSMCE2|HNRNPC|HNRNPU|SNAI2|PPHLN1|TLK2|XRN1|TADA3|ARRB1|FMR1|TERF2IP|MORC2|BRD7|CDC45|WDR61|CCT4|TOP2A|CCT8|RPS6KA4|CCT2|RB1|ATAD2B|AUTS2|TTK|CTBP1|DDX11|ANAPC5|NAT10|OTUB1|RTF1|KDM4D|PHF1|KAT7|TRIP12|PAF1|CENPF|SRC|HDAC8|KLHL22|CDC27|ATF7IP|KDM3A|PIWIL2|SETDB1|RAD50|MIER1|BUB1|SMG1|HNRNPA1|GEN1|PRKCQ|UBE2N|PHF19|RUVBL2|BRD4*	260	1.7925	0.0888
GO_NCRNA_CATABOLIC_PROCESS	*EXOSC6|DROSHA|EXOSC4|EXOSC2|EXOSC10|EXOSC7|XRN1|NUDT16|EXOSC8|DIS3L|ZCCHC8|PARN|DIS3L2|DIS3|RBM7|EXOSC9|EXOSC3|EXOSC5|PNPT1|PELO|POP1|SND1*	22	1.7921	0.0886

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
TOYOTA_TARGETS_OF_MIR34B_AND_MIR34C	*CENPO|NUFIP1|WEE1|ZNF91|CKAP2L|MIS18A|RAD51D|SKP2|ZNF623|PARN|FEN1|COQ2|XPO5|BCCIP|RBBP4|TFDP1|C6ORF89|MPHOSPH8|CCDC9|TRIM33|ANKLE2|PHGDH|COPS7B|ARHGAP32|DCLRE1C|TMEM109|TUBE1|ARHGEF26|DDX21|LIG1|MRRF|NUP210|SUN2|ZBTB8A|SKA1|POM121|BCAP29|TBC1D5|SHMT1|RTKN2|EIF5A|TSR2|SCAF4|SAMD1|CCNF|MYBL2|GALNT11|RFXAP|TUBB|GNPDA1|CENPE|RAN|TCF19|PIGX|CHST12|DESI2|PHLDB2|MCU|SNRNP70|PCBD2|TSEN54|MLLT1|MNS1|KPNB1|MBOAT2|CPSF6|C20ORF27|LPCAT2|RIF1|PPP6R2|REEP4|NRGN|NOP56|TMED4|FIP1L1|LMNB1|PLK1|PABPC4|PHTF2|BRI3BP|AP5B1|GOLM1|SRSF4|RAD51|RPL23|VPS54|MSL1|LDHA|FOXM1|CWC25|CCNA2|MIOS|CCDC93|LUC7L|ZNF273|NECAP1|POP1|PRPF19|STIL|APH1A|RAD54L2|IMPAD1|NCOR1|SLC35A4|RAD54L|CEP152|PSIP1|FAR2|RNASEH1|CASKIN2|NUSAP1|SOGA1|KIF15|DDX39B|ITFG2|KIF20B|PASK|HECTD2|GTSE1|ARAF|SAP30L|DLST|SMIM7|SACM1L|UBE2S|DNA2|LPCAT1|API5|M6PR|FAR1|KIF2C|TRMT61A|MANEAL|FOXRED1|PA2G4|BMPR1A|ZNF551|ATP2A2|STAG1|LRRC8C|FAM171A1|TCF7L2|CDK4|CNPY3|TNPO3|GPSM2|RIC8B|HAUS4|TNFRSF21|LRP11|KIF11|PSRC1|LMAN2L|METTL9|ARHGAP19|NEDD1|PPFIA1|L2HGDH|SHPRH|VPS45|BUB1B|NEK2|NFATC3|CC2D1A|DTL|RAB3D|CCNE2|HSPD1|PFN2|SPC24|USP5|RIOK1|ALMS1|NEDD4|PPP4R1|MIS18BP1|MED22|PAN2|ASF1B|PRKAG1|HNRNPUL1|C1ORF21|MKI67|SLC7A11|DENND5B|RAP1GAP|DNM1L|RFC3|STRBP|DIAPH1|CLSPN|AURKB|ADCK2|MAPT|ARHGAP11A|KIF4A|NOL10|RRM2|STK38L|ABCF1|UNG|ZC3H13|VOPP1|SETD2|FUS|HNRNPD|METTL15|ILF3|HNRNPAB|SF1|TEX261|DHX9|AURKA|PKMYT1|IQCC|HDAC6|MDN1|MCM3|PTP4A2|RAVER2|HMGN4|B4GALT3|TAGLN2|ATAD5|GINS3|WDR36|GTF2I|KIFC1|RFC2|SLC29A1|TRIP13|USP14|SUV39H1|POLD3|DIDO1|MCM8|SHCBP1|CCNB1|OXCT1|MPHOSPH9|LHFPL2|ZMYND8|CEP72|TMEM97|DENR|SMAD2|ZNF141|MSH5|XRCC6|CALML4|PPIP5K1|VTI1A|CDCA7|MMS22L|CDCA2|MLX|NFKBIB|TMEM18|RAPGEF6|DCTN5|EIF2S2|KLHDC4|ENAH|RAB3IP|FLOT1|SH3GLB2|ERP29|FANCD2|ARID1A|PDRG1|TICRR|CRTC3|UPF2|SYNE2|SHQ1|ANP32B|CENPJ|TRA2A|BARD1|UTP23|KRIT1|ZBTB20|BRIP1|KIF14|HNRNPA3|KAT7|CENPF|HDAC8|SACS|FASTKD2|SNRNP48|ARL13B|UGGT2|TOMM40|ERLIN1|SNX17|GPR19|FIGNL1|XPO6|HAUS6|MANEA|SREK1IP1|GEN1|HELLS|SLC25A19|POGK|CANT1|TUBGCP3|ZNF639|POLE|POLR1E|IDH3B|RBM17|PITHD1|ANAPC7|WWP2|PSME3|CSPP1|MELK|YWHAZ|ARHGDIA|NAV1|ABHD2|MZT2B|AFG3L2|SMPD4|CEP85*	327	1.7911	0.089
GO_GENE_SILENCING	*CHMP1A|CNOT2|MRPL44|SEC13|PCGF1|NRDE2|CNOT6|HMGB1|NUP50|PHF2|HELZ|UBE2B|CDK2|NUP54|CNOT10|MORF4L1|MBD1|DGCR8|XPO5|ZFP36|MORF4L2|HIRA|SCMH1|ADAR|MPHOSPH8|NUP133|SRRT|DDX4|ASF1A|NUP153|SMARCA5|ERI1|POLR2B|MECP2|SIRT1|TNRC6A|HDAC2|NUP210|EZH2|POLR2C|NUP43|POM121|RBM4|HNRNPA2B1|NAA40|PUM2|POLE3|NUP93|AJUBA|SNIP1|GIGYF2|POLR2A|NUP98|PCGF2|ZC3H7B|LIMD1|NCBP1|NUP188|ZMPSTE24|CNOT3|RAN|PHF8|DHX9|RANBP2|SEH1L|TP53|SMCHD1|PRKRA|CELF1|MBD3|TPR|POLR2F|SUV39H1|DROSHA|ATAD2|ZNFX1|MOV10|RIF1|DNMT1|HMGA1|NUP205|NCOR2|PPP3CA|NUP85|TRIM28|EED|DOT1L|POLR2K|SIRT6|FXR1|BCDIN3D|POLR2H|EIF6|SMAD2|SMAD1|MBD2|SRCAP|SIN3A|AAAS|MAP2K2|EGFR|NUP107|POLR2G|PPHLN1|DDX5|POLR2D|RAE1|NUP88|CLP1|HAT1|NUP160|POM121C|TARBP2|NUP37|ARID1A|RIPK1|NCOR1|FMR1|NCBP2|MORC2|DNMT3A|CDC45|ZC3H7A|HDAC5|TSNAX|DICER1|METTL3|SOX6|EZH1|ATAD2B|POLR2L|CTBP1|CNOT6L|CNOT7|NUP35|PUM1|CNOT1|TGFB1|BEND3|HDAC1|IPO8|NUP214|BAZ2A|PABPC1|ELAVL1|STAT3|PPM1D|NUP62|ATF7IP|FAM172A|TNRC6B|TDRKH|MSL3P1|SND1|POLR2I|RRP8|MAP2K1|SETDB1|PIWIL2|SIRT2|UBR2|MIER1|POLR2E|POLR2J|CNOT8|HELLS|TSN|NUP155|EIF4G1|MSL3|SMAD3|DDX17|ZC3H10|TNRC6C*	174	1.7902	0.0893

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
GO_TRNA_METABOLIC_PROCESS	*PUS3|LCMT2|AIMP2|DARS2|POP7|EXOSC8|WDR4|IARS2|NARS2|TARBP1|TPRKB|CDKAL1|RPP38|ELP6|LARS2|MTFMT|THUMPD1|THUMPD2|FTSJ1|ZBTB8OS|MARS2|CDK5RAP1|C2ORF49|TARS2|PTCD1|TRMT10A|ELAC1|TYW1|FARSB|NSUN6|OSGEP|MOCS3|THADA|ELP2|NSUN3|SEPHS2|THG1L|CTU1|SARS2|GRSF1|ALKBH1|METTL2B|EXOSC7|METTL2A|URM1|HARS2|TSEN54|PUSL1|AIMP1|METTL6|TRDMT1|DDX1|PUS7|TRMT6|RPP25|ADAT1|MTO1|DTD2|DALRD3|BCDIN3D|EXOSC3|AARS2|TRNT1|OSGEPL1|EARS2|LSM6|RPUSD4|CARS2|YARS2|RARS2|CLP1|SEPSECS|TRMT1|TRMT61B|GATC|ADAT2|ELP5|POP1|RPP14|KTI12|TYW3|DUS3L|TRUB1|EXOSC2|EXOSC10|LAGE3|FARSA|GTPBP3|PARS2|TRMT13|ADAT3|VARS2|TRPT1|TRMT11|SEPHS1|THUMPD3|PUS10|EXOSC9|PPA1|TSEN34|POP4|ELP3|EEF1E1|TRMT112|WARS2|NAT10|ELAC2|METTL1|CTU2|TRIT1|NSUN2|DUS1L|CSTF2|PUS1|TSEN2|ELP4|ANKRD16|TRMT61A|TSEN15|QTRT1|TP53RK|TRMT1L|RPP30|QRSL1|TRMT5|SSB|METTL8|RPP21|HSD17B10|POP5|RPP40|POLR3K|ALKBH8|TYW5|CPSF1|DTD1|TRMT10C|TRMU|PPA2|FAM98B|CPSF4|FARS2*	142	1.7898	0.089
REACTOME_HOMOLOGOUS_DNA_PAIRING_AND_STRAND_EXCHANGE	*RAD51|WRN|EXO1|DNA2|RPA1|RAD51AP1|CHEK1|TOPBP1|BRCA2|RAD51D|RFC5|ATM|ATRIP|KAT5|RPA2|XRCC3|RAD1|RFC2|RAD17|RPA3|RAD9A|RAD51B|RAD50|RMI2|ATR|RFC3|PALB2|NBN|HUS1|RAD51C|BARD1|BRCA1|RBBP8|RFC4|BLM|TOP3A|RMI1|BRIP1*	38	1.7889	0.0893
MORI_LARGE_PRE_BII_LYMPHOCYTE_UP	*NCAPH|CDCA7|DTL|PRC1|CDCA3|CDCA5|HMGB1|CBX1|CKS1B|TUBB4B|CCNA2|RBBP4|ASF1B|HMGB3|CDC20|MKI67|RRM1|KPNA2|TOP2A|LGALS1|SMARCC1|PRDX4|ZNF358|HMGN2|STMN1|LIG1|PPP2R5C|ANP32E|RANGAP1|CDK1|SMARCA4|TTK|RRM2|SMC2|CENPL|ANAPC5|MYBL2|KIF22|TUBB|CDKN1A|HNRNPAB|CENPE|RAN|AURKA|E2F8|SMC4|UBE2S|FANCC|CMC2|MCM2|MCM3|HAUS3|RACGAP1|RAD21|NUCKS1|IDE|TXN|SLC29A1|HMGA1|PSMC1|TMPO|KIF23|MCM7|BUB3|CCNB1|SLBP|LMNB1|CCNB2|MCM6|CDKN3|MELK|HJURP|TUBA1A|XRCC6|RAMP1|ALYREF|NDC80*	77	1.7885	0.0891
GO_TELOMERE_MAINTENANCE_VIA_SEMI_CONSERVATIVE_REPLICATION	*POLA2|UPF1|DNA2|RPA1|RTEL1|PRIM1|RFC5|FEN1|RPA2|RFC2|POLE4|TERF2|POLE2|RPA3|PCNA|POLA1|RFC1|POLD3|POLD1|PRIM2|TERF1|RFC3|POLD2|POLE|POLE3|RFC4*	26	1.7882	0.0888
GO_MRNA_CIS_SPLICING_VIA_SPLICEOSOME	*SRSF12|NCBP1|WBP4|CWC15|PRPF39|PRPF40B|SRSF6|SFSWAP|WBP11|SRSF1|SART1|SRSF2|NCBP2|PSIP1|DCPS|SRSF9|RBM22|PRPF40A|RBM4|RBM19|SRSF7|RBM4B|SNRNP200|SRSF3|SRSF8|DDX23|SRSF4|SRSF5|SNRPC*	29	1.7872	0.089
GO_MATURATION_OF_SSU_RRNA_FROM_TRICISTRONIC_RRNA_TRANSCRIPT_SSU_RRNA_5_8S_RRNA_LSU_RRNA	*RPS19|BYSL|MRPS11|ERCC2|RPS16|RRP36|TBL3|KRI1|FAM207A|RRS1|UTP6|RPS8|UTP20|RCL1|RPS14|BMS1|DHX37|HEATR1|BTRC|TSR1|DCAF13|UTP3|WDR46|RPS21|NOP14|ABT1|NOL10|TSR2|UTP23|NGDN*	30	1.7865	0.0891

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
GO_DNA_REPLICATION	*RECQL5|RECQL4|UPF1|EME1|SENP2|SMARCAL1|THOC1|CHEK1|ORC5|TOP1MT|REV3L|GINS4|FEN1|TBRG1|EHMT2|ORC6|NFIA|RBBP4|POLI|PRIM2|TNFAIP1|ZRANB3|ORC4|KIN|CINP|LIG1|NBN|REPIN1|WIZ|SET|ORC2|ATRX|ZMPSTE24|EME2|RPA1|BOD1L1|TTF1|RTEL1|TP53|POLK|PTMS|ATF1|GLI1|NUCKS1|RBMS1|SUPT16H|PURA|RFC1|LIG3|TREX1|RAD9A|HMGA1|PPP2R1A|TSPYL2|ETAA1|ING5|PNKP|FAF1|ALYREF|ORC1|SIN3A|RAD51|POLA2|INO80|TIPIN|RPAIN|CDT1|CCNA2|CTC1|LIG4|KAT5|ATM|MAP2K4|CDC7|WRNIP1|EXD2|CHTF18|E4F1|TONSL|ID3|CDK2AP1|RNASEH2A|CHEK2|DNA2|MSH3|PRIM1|POLG|SLX4|RPA2|RAD17|CHAF1B|ING4|NAP1L1|GRWD1|GINS2|DTD1|CDK9|MCM10|LRWD1|TOP3A|EXO1|DTL|GINS1|CCNE2|CDC42|S100A11|POLG2|CDK2|ATRIP|TOP1|SDE2|RRM2B|TERF2|ORC3|SETMAR|POLA1|FAM111A|RRM1|FBXO5|ATR|RFC3|POLB|NFIX|CLSPN|CCDC88A|CDC34|CHAF1A|DBF4|SSBP1|CDC6|ATG7|CDK1|NFIB|POLE3|RRM2|BRCA1|SAMHD1|RBBP8|BLM|MCMBP|E2F7|USP37|WDHD1|DUT|GMNN|DHX9|MCM5|E2F8|PDS5A|SMC3|TOPBP1|ANKRD17|MCM2|MCM3|JUN|MCM4|RFC5|ATAD5|RAC1|GINS3|TIMELESS|RAD1|NASP|RFC2|POLE4|POLE2|HELB|CACYBP|PCNA|POLD3|POLD1|RMI2|NFIC|DONSON|TERF1|MCM8|STOML2|MCM7|DNAJA3|HUS1|POLL|MCM6|RFWD3|RECQL|RFC4|RMI1|MMS22L|RBBP7|EGFR|WDR18|BAZ1A|PPP2CA|GTPBP4|KCTD13|DNAJC2|CDC45|IGHMBP2|REV1|TICRR|FGFR1|BARD1|DDX11|POLH|BRIP1|WRN|KAT7|CHTF8|ESCO2|BRCA2|ZBTB38|HRAS|ZNF830|CDAN1|RPA3|SSRP1|MCM9|RAD50|GEN1|POLD2|POLE|RBBP6|ESCO1|DSCC1*	223	1.785	0.0898
GO_NEGATIVE_REGULATION_OF_PROTEIN_DEPHOSPHORYLATION	*GNAI2|SWAP70|MASTL|PPP1R1B|PPP1R8|PPP1R14B|BOD1L1|PPP1R10|GSK3B|ROCK2|PTN|URI1|PHACTR2|PPP1R35|FKBP1A|PPP1R37|PPP1R14C|MFHAS1|YWHAE|YWHAB|CABIN1|TIPRL|PPP1R9B|PPME1|LGALS3|BOD1|PPP1R11|PPP1R1A|MGAT5|ARPP19|FAM122A|SET|ROCK1|SH3RF2|LMTK2|CRY2|ENSA|IKBKB|PPP1R2*	39	1.7846	0.0896
CHIARETTI_ACUTE_LYMPHOBLASTIC_LEUKEMIA_ZAP70	*DGKA|EPM2AIP1|ITGA5|TTN|COA1|ACOT8|PI4KA|HPS1|ANXA11|ATM|HMGXB3|PBX3|SEMA6A|CRADD|BRF1|E2F4|PHC2|TP53BP1|SF3B3|TRIP6|BAIAP2|IFT20|XPC|CASP8|ITFG2|AP3D1|VCAN|ACVR2A|SLC2A1|GAB1|AIP|CDK9|TCF20|STK39|CTNND1|AGPS*	36	1.7808	0.0926

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
WONG_EMBRYONIC_STEM_CELL_CORE	*WEE1|RPL27A|MTF2|RPS16|POP7|ACAD8|CDCA5|CHEK1|NUDCD2|TGIF1|LSM10|ABCB7|RPL13|UBE2G1|SNRPD1|EEF2|CDC20|GJA1|PRIM2|COQ3|BAX|EIF3A|CISD1|CCNC|MRPL11|CYCS|LSM2|SLC2A1|SET|SERPINH1|RPS23|CCNF|SEPHS2|MYBL2|TIMM13|MAD2L1|KIF22|GNPDA1|EIF2S3|RAD18|TCF19|MRPL4|DAP3|EXOSC7|E2F3|APEX1|TP53|UBE2V2|YY1|UGDH|RPS27|MID1IP1|PRMT1|LYPLA1|DEK|NIPSNAP1|LMNB1|PLK1|SS18|MRPS18B|DLGAP5|RCC2|EIF6|CRABP2|NT5DC2|ALDOC|SUMO1|ORC1|TEAD2|MRPS28|NUP107|CDCA3|BRIX1|ADSL|G3BP1|RPS5|PHC1|CKS1B|CCNA2|HAT1|RPL22|NTHL1|CDC7|GEMIN6|WBP11|ETFA|FH|PHB|WDR77|PPP4C|IPO9|RNPS1|NUSAP1|EIF4B|PRPS1|GART|THOC3|SOX2|SNRNP40|ANP32E|GLDC|SMC2|GTSE1|PSMA7|CHEK2|PPM1G|YAP1|BTF3|FBL|ADH5|PRIM1|CCT5|LSM4|PSMB6|RPS8|PA2G4|RPA2|XRCC5|CDCA8|EIF4EBP1|PRDX1|TCF7L1|CDK4|RPS3|NAP1L1|SSB|NOP2|RPP40|PDIA4|NDUFB8|CCNB2|KIF11|XPO1|SQLE|CDKN3|CKAP2|PDHA1|DTYMK|MTHFD2|ELOVL6|NDC80|MRPL12|BUB1B|NONO|GSPT2|NEK2|HSPE1|EXO1|PIPOX|DTL|EMC8|DARS2|COX5B|GEMIN2|PRMT3|RUVBL1|ECHS1|RPL10A|FAM136A|RRM1|GNL3|KPNA2|VBP1|RFC3|PSMD14|HADH|CTSC|AURKB|MRPS36|MRPL16|CDC34|DBF4|CHAF1A|KIF4A|CDC6|MRPL39|BANF1|CDK1|CSE1L|NME4|RRM2|NDUFS2|EIF4A1|BCAT1|EIF3I|SNRPA1|BLM|CCND2|LSM5|CLPP|GLO1|FDPS|WDHD1|GMNN|HNRNPAB|PHF5A|DHX9|MCM5|AURKA|SMC4|PARP1|HMGN5|MCM2|MCM3|VRK1|MCM4|CTNNA1|RPS12|PDPN|NASP|NLN|DLAT|POLE2|TRIP13|KIF20A|STIP1|POLR2F|SLC25A5|PCNA|HNRNPK|DNMT1|DPP3|SNRPA|POLD1|MRPL13|RPSA|HMGB2|TERF1|KRAS|KIF23|NHP2|MCM7|STOML2|BUB3|MRPS2|RCC1|NCAPD2|NDUFA9|MRPS17|NCL|HNRNPL|MRTO4|MSH2|MRPL37|TIMM44|HSPA14|RPS19|NCAPH|CDCA7|SDHC|EIF2S2|TGIF2|EBNA1BP2|ERP29|MRPL15|HAUS1|BIRC5|NCBP2|RCN2|FGFR1|TOP2A|TRIP6|PSMA5|RAD23B|FARSA|ALDH7A1|ZNF22|HSPA9|TTK|MRPS30|SDHD|SPAG5|EIF3K|EEF1E1|CSRP2|NDUFA11|NIP7|HDAC1|PDCD2|PSMB5|PABPC1|TIMM8B|RACGAP1|PUS1|CDKN1C|CKS2|TCOF1|DDX18|EIF3L|UQCRH|RPA3|UQCR11|NDUFB10|ENO1|BUB1|NDUFB7|HNRNPA1|NDUFAB1|SNX5|HELLS|UTP18|NOP10|POLR3K|SLC16A1|KPNA6|PSME3|RUVBL2|ERCC6L*	308	1.7805	0.0924
REACTOME_MRNA_DECAY_BY_3_TO_5_EXORIBONUCLEASE	*EXOSC6|EXOSC4|SKIV2L|EXOSC1|EXOSC2|WDR61|DCPS|EXOSC7|EXOSC8|DIS3|EXOSC9|EXOSC3|EXOSC5|HBS1L|TTC37*	15	1.7799	0.0924
GO_CHROMOSOME_SEPARATION	*BUB1B|RECQL5|NCAPH|ANAPC1|RIOK2|EME1|NCAPH2|CDT1|TEX14|ATM|XRCC3|NEK6|MAD1L1|CDC23|MAD2L2|CUL3|CDC20|MLH1|ZW10|FBXO5|LCMT1|NUMA1|TOP2A|MUS81|PTTG1|AURKB|DIS3L2|RB1|CDC6|TTK|ANAPC5|MAD2L1|CENPE|EME2|ZNF207|PCID2|CENPF|ANAPC4|KLHL22|SMARCAD1|SLX4|CDC27|RAD21|NCAPD3|ESPL1|CDC26|TRIP13|TPR|BUB1|TOP2B|GEN1|BUB3|CCNB1|TACC3|CSNK2A2|CSNK2A1|PLK1|ANAPC11|NCAPD2|SPDL1|PPP2R1A|PSMG2|DLGAP5|DYNC1LI1|CDK5RAP2|APC|ERCC4|HECW2|IK|TOP3A|RMI1|NDC80|NSMCE2*	73	1.778	0.0934

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
GO_REGULATION_OF_GENE_EXPRESSION_EPIGENETIC	*CDYL|UPF1|ZNF335|MTF2|SEC13|NRDE2|CHEK1|PCGF6|NUP50|HELZ|TDG|MORF4L1|XPO5|ZFP36|MORF4L2|RBBP4|MPHOSPH8|POLR1A|POLR1B|NUP133|ASF1A|CTCF|NUP153|GSK3A|MECP2|SIRT1|DDX21|NUP210|POLR2C|POM121|HNRNPA2B1|GIGYF2|NUP98|PCGF2|LIMD1|ZMPSTE24|RAN|SEH1L|TP53|SMCHD1|PRKRA|CELF1|EP300|POLR1C|TPR|DROSHA|MOV10|RIF1|HMGA1|DEK|WBP2|NCOR2|RBM15|EED|POLR2K|FXR1|BCDIN3D|POLR2H|EIF6|MBD2|SIN3A|ZMIZ2|AAAS|DNMT3B|NUP107|NUP88|CLP1|RBM15B|HAT1|POM121C|TARBP2|RIPK1|NCOR1|EXOSC10|HDAC5|TSNAX|CTNNB1|METTL3|RLIM|CNOT7|ACTB|PUM1|ERCC6|CNOT1|TWISTNB|TGFB1|NUP214|BAZ2A|ELAVL1|LHX2|EPC1|STAT3|PPM1D|FAM172A|POLR2I|MAP2K1|TRIM27|BAZ1B|GPX1|UBR2|TSN|KAT2A|MTA1|MSL3|TNRC6C|ARID1B|MRPL44|PCGF1|CNOT6|HMGB1|PHF2|UBE2B|NUP54|IFI16|MBD1|DGCR8|HIRA|ADAR|SRRT|GLMN|SMARCA5|PADI2|POLR2B|TAF1B|TNRC6A|HDAC2|EZH2|SF3B1|NUP43|TFAP2C|KAT2B|RBM4|NAA40|PUM2|POLE3|NUP93|AJUBA|BRCA1|SNIP1|POLR2A|ZC3H7B|NUP188|SPHK2|SMARCD1|TBP|PHF8|DHX9|RANBP2|CREBZF|HDAC6|YTHDC1|SUZ12|MBD3|POLR2F|SUV39H1|ATAD2|ZNFX1|DNMT1|TAF1C|NUP205|PPP3CA|NUP85|TRIM28|CD3EAP|DOT1L|SIRT6|SMAD2|SMAD1|RBBP7|HNRNPU|MAP2K2|EGFR|POLR2G|PPHLN1|DDX5|POLR2D|RAE1|MYO1C|NUP160|NUP37|ARID1A|FMR1|MORC2|DNMT3A|CDC45|ZC3H7A|ELOF1|DICER1|EZH1|ATAD2B|POLR2L|CTBP1|NUP35|HDAC4|PRMT7|BEND3|HDAC1|PCGF5|PHF1|IPO8|ZMIZ1|AEBP2|MYBBP1A|ARID4B|ARID4A|NUP62|ATF7IP|TNRC6B|LRIF1|MSL3P1|RRP8|SETDB1|KDM1B|SIRT2|MIER1|POLR2E|POLR2J|CNOT8|HELLS|NUP155|POLR1E|PHF19|EIF4G1|SMAD3|ZC3H10|ZNRD1*	226	1.7776	0.0934
REACTOME_TELOMERE_MAINTENANCE	*POLA2|WRN|DKC1|DNA2|TINF2|RPA1|CHTF8|RTEL1|PRIM1|RFC5|FEN1|CTC1|RUVBL1|RPA2|RFC2|TERF2|RPA3|POLA1|CHTF18|RFC1|PCNA|TERF2IP|POLD3|GAR1|PRIM2|POLD1|TERF1|RFC3|NHP2|LIG1|POLD2|NOP10|WRAP53|RUVBL2|POT1|DSCC1|BLM|RFC4*	38	1.7768	0.0936
GO_SISTER_CHROMATID_COHESION	*BUB1B|KIF22|PDS5B|TNKS|PDS5A|SMC1A|CHTF8|ESCO2|SMC3|CDCA5|MAU2|HDAC8|FEN1|RAD21|ESPL1|DDX12P|STAG3|STAG2|STAG1|CDC20|PHB2|CTCF|BOD1|BUB1|NAA50|POGZ|SFPQ|CTNNB1|PLK1|SMC5|PPP2R1A|RAD51C|NIPBL|SMC1B|ESCO1|RB1|DDX11|DSCC1|MCMBP|ATRX|NAA10|NSMCE2*	42	1.7726	0.0972
GO_PROTEIN_METHYLATION	*RAB6A|CARM1|PRDM2|ZNF335|MTF2|RAB3D|PRMT3|WDR5|EHMT2|WDR82|PCMT1|SETMAR|CTCF|PWP1|PRMT6|MECP2|PAXIP1|SIRT1|EZH2|SUV39H2|SNRPD3|ASH2L|SMAD4|PIH1D1|ICMT|BRCA1|SETD2|SETD7|ATRX|FBXO11|NSD1|MLLT6|N6AMT1|SUZ12|CXXC1|PRMT2|PAGR1|RLF|NDUFAF7|FAM98A|PRMT1|SUV39H1|PYGO2|LMNA|DNMT1|SETD1B|RIF1|SUPT6H|ETF1|CAMKMT|MECOM|KPNA7|TET2|EED|NTMT1|DOT1L|SMYD2|SMARCB1|RNF20|DNMT3B|FBLL1|RBBP5|PRMT5|SETD5|SMYD3|EHMT1|MEN1|PCMTD1|COPRS|ZNF274|LCMT1|WDR61|CTNNB1|MTHFR|EZH1|TTLL12|SETD6|AUTS2|SETD3|TRMT112|CTR9|IWS1|PRMT7|RTF1|PCMTD2|KDM4D|BEND3|FBL|SNW1|GSPT1|PHF1|KDM6A|PAF1|BCOR|SNRPB|ARID4B|ARID4A|CHTOP|KDM3A|SETDB1|OGT|METTL21A|SETD1A|KDM1A|PHF19|ASH1L|RAB3B|KDM4C|BRD4|FAM98B|BHMT*	111	1.7718	0.0973
GO_PROTEIN_LOCALIZATION_TO_CYTOSKELETON	*BBS4|HNRNPU|AURKA|CEP192|UBXN2B|GSK3B|MID1|PIBF1|PCM1|GOLGB1|DISC1|BICD1|NUP62|CEP250|CCDC14|C2CD3|STIL|MAPRE1|MAPRE3|CSNK1D|MAP1A|PPP1R9B|ANLN|HOOK3|MAPRE2|FAM83D|NUMA1|DCTN2|GAS2L1|DIAPH1|CHAMP1|MARK4|NSFL1C|NUDCD3|KIF20B|KIAA0753|DVL1|CRIPT|TTK|NEDD1|CEP72|RTKN|SPAG5|APC*	44	1.771	0.0976
GO_CALCIUM_ION_IMPORT	*TRPM2|SPHK2|CASK|ZMPSTE24|MICU1|ATP2B4|MCU|FYN|CDK5|SLC25A23|PDGFRB|ORAI1|ATP2A2|SLC8A1|OPA1|RAMP3|TRIM27|STC1|CACNA2D1|LGALS3|PRNP|PKD2|SLC30A1|CTNNB1|HOMER1|WNK3|AFG3L2*	27	1.7702	0.0977

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
HORIUCHI_WTAP_TARGETS_DN	*CDH2|CKAP2L|CRIP2|COX7B|HMMR|PDE1C|RPL13|PLP2|ARL6IP6|PBK|TMEM33|CDC20|TDP2|ASF1A|WWTR1|NAA50|COQ3|PTTG1|FLNA|CCNC|BCAP29|SHMT1|ANKRD46|CEP55|LEPROTL1|MYBL2|NUP98|MAD2L1|KIF22|PNRC2|LDHB|NEGR1|SKA3|TROAP|NUCKS1|ENY2|KPNB1|HMGA1|CCDC86|LMNB1|PLK1|DRG2|NDUFA7|NAA15|DLGAP5|LIN7C|MAVS|RNF11|GSR|PRC1|LDHA|RPL15|FOXM1|CDCA3|CKS1B|CCNA2|UHMK1|CMPK1|GMFB|LRRC17|RPL22L1|PHB|FAM83D|OIP5|NUSAP1|MBNL1|DDX39B|TSNAX|ZNF618|PEX13|RPL3|DNAJC10|GTSE1|SRPRB|PHF10|PRR11|TWISTNB|APOBEC3B|USP28|RPRD2|FBL|RPL13A|GSPT1|UBE2S|TIMM50|LBR|IPO11|CENPN|LSM4|SLC5A3|ESPL1|KIF2C|FECH|CDCA8|PI4K2B|C11ORF58|SPATS2L|LRRC8C|ING3|ASPM|FUT11|GSKIP|NAP1L1|ARL5B|CCNB2|KIF11|PSRC1|SQLE|KIF18B|NCAPG|ARSB|CDKN3|CKAP2|HJURP|HMGCR|PGK1|PGRMC2|MPP4|PPP1R2|NDC80|BUB1B|POLR3G|NEK2|TMEM245|WDFY1|CENPM|PAPOLA|TPP1|WTAP|RAD51AP1|C12ORF57|SPC24|HSP90AA1|DCXR|SPC25|MBTPS2|ASF1B|C1D|MGP|POLA1|RRM1|MKI67|TOR3A|TMED5|RPL7A|STUB1|AURKB|FASN|LMNB2|PALD1|KIF4A|CDC25B|DKK1|CDK1|MPRIP|KLHL8|PPM1A|MSTO1|RRM2|UNG|GLO1|ATL3|FDPS|GMNN|USP38|AURKA|TYMS|AKR1B1|NUF2|UBXN2A|TPX2|CD44|VRK1|UHRF1|RFC5|HACL1|PBRM1|TMEM123|UBE2C|NLN|DLAT|PEG10|TRIP13|KIF20A|FDFT1|SLC25A5|CCT7|BNIP2|SNRNP27|ANLN|ATP11C|HOOK3|TM9SF3|DPY19L1|POLD1|SNRPA|TWF1|TMPO|HMGB2|KIF23|MCM7|BUB3|CCNB1|CAT|CXADR|NCAPD2|ABCD3|MAP1B|SMAD5|SMAD2|TMEM97|ATG9A|CDCA2|LRP8|ENAH|TFB2M|FANCD2|BIRC5|TOP2A|PPIA|MRPL48|STYX|SEPHS1|TTK|DDX11|SPAG5|NMT2|ATP2C1|LAMP2|KIF14|ARF6|HNRNPA3|ACAT2|RACGAP1|TMEM64|CKS2|TMEM106B|EEF1B2|CDC27|IMPDH2|GLS|ZDHHC20|CANX|PAICS|RASSF2|CNN2|BUB1|HELLS|IFNAR1|PURB|FSD1|CSK|CENPW|ATXN10|RAB3B|C1QBP|MELK|TK1|CEP85*	259	1.769	0.0983
GO_HISTONE_H3_K9_METHYLATION	*KDM4D|BEND3|DNMT3B|ARID4B|ARID4A|EHMT2|SETD5|KDM3A|EHMT1|SUV39H1|LMNA|SETDB1|DNMT1|RIF1|ZNF274|MECP2|SIRT1|MECOM|SUV39H2|KDM1A|ASH1L|SMARCB1|PIH1D1|BRCA1|KDM4C|SETD7|ATRX*	27	1.7674	0.0993
GO_REGULATION_OF_VIRAL_TRANSCRIPTION	*GTF2B|CTDP1|POLR2G|POLR2D|TRIM62|ZFP36|TRIM21|TARBP2|REST|TRIM14|POLR2B|TRIM11|POLR2C|TRIM32|TARDBP|POLR2L|SMARCA4|TRIM13|POLR2A|HDAC1|DHX9|CHD1|SNW1|GTF2F2|TAF11|PSMC3|JUN|INPP5K|EP300|LEF1|NUCKS1|POLR2I|TRIM8|POLR2F|RSF1|TRIM27|CCNT1|POLR2E|POLR2J|SUPT4H1|RRP1B|ZNF639|SUPT5H|POLR2K|SMARCB1|POLR2H|TFAP4|SP1|CDK9|GTF2F1*	50	1.7666	0.0995
REACTOME_EXTENSION_OF_TELOMERES	*POLA2|WRN|DKC1|DNA2|TINF2|RPA1|CHTF8|RTEL1|PRIM1|RFC5|FEN1|CTC1|RUVBL1|RPA2|RFC2|TERF2|RPA3|RFC1|POLA1|CHTF18|PCNA|POLD3|GAR1|TERF2IP|POLD1|PRIM2|TERF1|RFC3|NHP2|LIG1|POLD2|NOP10|WRAP53|RUVBL2|POT1|DSCC1|RFC4|BLM*	38	1.7665	0.0991
HWANG_PROSTATE_CANCER_MARKERS	*PHB|AZGP1|PTEN|LGALS3|RAN|MIF|LGALS1|PARK7|FLNA|CTNNB1|CLU|CALR|HSPA6|FKBP5|KPNB1|SELENBP1|PGK1|EZR|TXN|NDRG1|ILK*	21	−2.181	0.0834
REACTOME_SPRY_REGULATION_OF_FGF_SIGNALING	*UBA52|RPS27A|UBB|GRB2|PPP2CB|SPRY2|SRC|PPP2R1A|MAPK1|BRAF|PTPN11|MAPK3|PPP2CA|MKNK1|CBL*	15	−2.2183	0.0752
REACTOME_NEGATIVE_REGULATION_OF_FGFR3_SIGNALING	*UBA52|RPS27A|UBB|FGF2|GRB2|PPP2CB|SPRY2|SRC|PPP2R1A|MAPK1|BRAF|PTPN11|MAPK3|FGF1|PPP2CA|MKNK1|CBL|FRS2*	18	−2.227	0.0851
REACTOME_NEGATIVE_REGULATION_OF_FGFR4_SIGNALING	*UBA52|RPS27A|UBB|FGF2|GRB2|PPP2CB|FGFR4|SPRY2|SRC|PPP2R1A|MAPK1|BRAF|PTPN11|MAPK3|FGF1|PPP2CA|MKNK1|CBL|FRS2*	19	−2.2976	0.0638

Supplementary Table S1. Continued

Term	Genes	Count	NES	q-value
REACTOME_NEGATIVE_REGULATION_OF_FGFR1_SIGNALING	*UBA52*|*RPS27A*|*FGFR1*|*UBB*|*FGF2*|*GRB2*|*PPP2CB*|*SPRY2*|*SRC*|*PPP2R1A*|*MAPK1*|*BRAF*|*PTPN11*|*MAPK3*|*FGF1*|*PPP2CA*|*MKNK1*|*CBL*|*FRS2*	19	−2.3579	0.0477
REACTOME_TP53_REGULATES_METABOLIC_GENES	*SCO1*|*GSR*|*AKT1*|*LAMTOR5*|*COX5B*|*SESN1*|*COX7B*|*COX14*|*LAMTOR2*|*COX4I1*|*PRKAA1*|*COX7C*|*TACO1*|*SLC38A9*|*RRM2B*|*YWHAH*|*PRKAG1*|*YWHAG*|*TSC1*|*COX5A*|*PRKAB1*|*LRPPRC*|*PTEN*|*COX6B1*|*MTOR*|*NDUFA4*|*TNRC6A*|*YWHAQ*|*SESN3*|*G6PD*|*RRAGD*|*CYCS*|*DDIT4*|*COX6A1*|*RHEB*|*COX7A2L*|*SCO2*|*COX18*|*RRAGC*|*GPI*|*TXNRD1*|*COX6C*|*PRKAG2*|*TSC2*|*TP53*|*COX11*|*PRDX2*|*PRDX5*|*RPTOR*|*COX16*|*GLS*|*YWHAE*|*TNRC6B*|*TXN*|*MLST8*|*YWHAB*|*COX8A*|*PRDX1*|*MOV10*|*SFN*|*AKT3*|*RRAGB*|*LAMTOR1*|*RRAGA*|*SURF1*|*LAMTOR4*|*LAMTOR3*|*COX20*|*AKT2*|*TNRC6C*|*YWHAZ*|*SESN2*|*PRKAA2*	73	−2.3816	0.0558

NES: normalized enrichment score.

Supplementary Table S2. Kinase profiling of DNK72 (1 μM)

Kinase	DNK72 (1 μM)	Kinase	DNK72 (1 μM)	Kinase	DNK72 (1 μM)	Kinase	DNK72 (1 μM)	Kinase	DNK72 (1 μM)	Kinase	DNK72 (1 μM)	Kinase	DNK72 (1 μM)
AAK1	90	CDC2L5	100	EPHA4	100	INSRR	3.2	MLK2	96	PIK3CD	78	SGK2	100
ABL1(E255K)-phosphorylated	100	CDK11	96	EPHA5	100	IRAK1	100	MLK3	86	PIK3CG	87	SGK3	87
ABL1(F317I)-nonphosphorylated	56	CDK2	98	EPHA6	100	IRAK3	26	MRCKA	100	PIK4CB	99	SIK	100
ABL1(F317I)-phosphorylated	29	CDK3	93	EPHA7	94	IRAK4	100	MRCKB	100	PIKFYVE	100	SIK2	100
ABL1(F317L)-nonphosphorylated	74	CDK4	100	EPHA8	93	ITK	100	MST1	100	PIM1	80	SLK	97
ABL1(F317L)-phosphorylated	35	CDK4-cyclinD1	55	EPHB1	100	JAK1(JH1domain-catalytic)	100	MST1R	95	PIM2	100	SNARK	91
ABL1(H396P)-nonphosphorylated	96	CDK4-cyclinD3	53	EPHB2	91	JAK1(JH2domain-pseudokinase)	55	MST2	71	PIM3	73	SNRK	69
ABL1(H396P)-phosphorylated	74	CDK5	100	EPHB3	100	JAK2(JH1domain-catalytic)	100	MST3	84	PIP5K1A	100	SRC	100
ABL1(M351T)-phosphorylated	100	CDK7	48	EPHB4	100	JAK3(JH1domain-catalytic)	100	MST4	100	PIP5K1C	100	SRMS	66
ABL1(Q252H)-nonphosphorylated	99	CDK8	86	EPHB6	95	JNK1	25	MTOR	100	PIP5K2B	100	SRPK1	100
ABL1(Q252H)-phosphorylated	82	CDK9	100	ERBB2	100	JNK2	23	MUSK	94	PIP5K2C	77	SRPK2	74
ABL1(T315I)-nonphosphorylated	100	CDKL1	88	ERBB3	100	JNK3	18	MYLK	0.95	PKAC-alpha	100	SRPK3	100
ABL1(T315I)-phosphorylated	98	CDKL2	100	ERBB4	100	KIT	56	MYLK2	100	PKAC-beta	100	STK16	69
ABL1(Y253F)-phosphorylated	86	CDKL3	100	ERK1	100	KIT(A829P)	100	MYLK4	89	PKMYT1	100	STK33	13
ABL1-nonphosphorylated	91	CDKL5	100	ERK2	100	KIT(D816H)	100	MYO3A	78	PKN1	95	STK35	100
ABL1-phosphorylated	63	CHEK1	100	ERK3	95	KIT(D816V)	99	MYO3B	19	PKN2	100	STK36	100
ABL2	100	CHEK2	12	ERK4	92	KIT(L576P)	47	NDR1	94	PKNB (M.tuberculosis)	83	STK39	30
ACVR1	100	CIT	100	ERK5	18	KIT(V559D)	46	NDR2	100	PLK1	65	SYK	70
ACVR1B	100	CLK1	0.15	ERK8	100	KIT(V559D,T670I)	87	NEK1	93	PLK2	100	TAK1	100
ACVR2A	100	CLK2	0.9	ERN1	83	KIT(V559D,V654A)	94	NEK10	100	PLK3	89	TAOK1	85
ACVR2B	100	CLK3	4	FAK	3.8	KIT-autoinhibited	74	NEK11	100	PLK4	1.7	TAOK2	87
ACVRL1	97	CLK4	4.1	FER	3	LATS1	100	NEK2	74	PRKCD	100	TAOK3	81
ADCK3	100	CSF1R	88	FES	36	LATS2	87	NEK3	82	PRKCE	100	TBK1	84
ADCK4	100	CSF1R-autoinhibited	100	FGFR1	100	LCK	100	NEK4	100	PRKCH	100	TEC	86

Supplementary Table S2. Continued

Kinase	DNK72 (1 μM)	Kinase	DNK72 (1 μM)	Kinase	DNK72 (1 μM)	Kinase	DNK72 (1 μM)	Kinase	DNK72 (1 μM)	Kinase	DNK72 (1 μM)	Kinase	DNK72 (1 μM)
AKT1	100	CSK	85	FGFR2	96	LIMK1	100	NEK5	95	PRKCI	53	TESK1	100
AKT2	94	CSNK1A1	56	FGFR3	100	LIMK2	99	NEK6	100	PRKCQ	100	TGFBR1	100
AKT3	100	CSNK1A1L	15	FGFR3 (G697C)	100	LKB1	87	NEK7	94	PRKD1	11	TGFBR2	96
ALK	0.35	CSNK1D	2.6	FGFR4	38	LOK	100	NEK9	99	PRKD2	16	TIE1	100
ALK(C1156Y)	16	CSNK1E	4.2	FGR	100	LRRK2	1.2	NIK	16	PRKD3	17	TIE2	100
ALK(L1196M)	0.75	CSNK1G1	73	FLT1	100	LRRK2(G2019S)	2	NIM1	100	PRKG1	84	TLK1	72
AMPK-alpha1	100	CSNK1G2	100	FLT3	65	LTK	3.7	NLK	69	PRKG2	91	TLK2	93
AMPK-alpha2	100	CSNK1G3	90	FLT3(D835H)	21	LYN	100	OSR1	7.5	PRKR	85	TNIK	83
ANKK1	95	CSNK2A1	73	FLT3(D835V)	0	LZK	100	p38-alpha	96	PRKX	81	TNK1	16
ARK5	99	CSNK2A2	95	FLT3(D835Y)	14	MAK	100	p38-beta	100	PRP4	89	TNK2	31
ASK1	82	CTK	100	FLT3(ITD)	21	MAP3K1	83	p38-delta	95	PYK2	2.8	TNNI3K	100
ASK2	92	DAPK1	49	FLT3 (ITD,D835V)	15	MAP3K15	61	p38-gamma	89	QSK	97	TRKA	98
AURKA	87	DAPK2	35	FLT3 (ITD,F691L)	79	MAP3K2	92	PAK1	71	RAF1	100	TRKB	100
AURKB	90	DAPK3	56	FLT3(K663Q)	64	MAP3K3	87	PAK2	71	RET	98	TRKC	100
AURKC	100	DCAMKL1	49	FLT3(N841I)	51	MAP3K4	97	PAK3	100	RET(M918T)	96	TRPM6	98
AXL	69	DCAMKL2	93	FLT3(R834Q)	100	MAP4K2	69	PAK4	100	RET(V804L)	89	TSSK1B	0
BIKE	100	DCAMKL3	90	FLT3-auto-inhibited	76	MAP4K3	100	PAK6	91	RET(V804M)	87	TSSK3	100
BLK	100	DDR1	100	FLT4	97	MAP4K4	100	PAK7	85	RIOK1	100	TTK	1.4
BMPR1A	100	DDR2	100	FRK	77	MAP4K5	100	PCTK1	100	RIOK2	75	TXK	100
BMPR1B	83	DLK	100	FYN	100	MAPKAPK2	24	PCTK2	99	RIOK3	100	TYK2 (JH1domain-catalytic)	100
BMPR2	100	DMPK	100	GAK	1	MAPKAPK5	51	PCTK3	94	RIPK1	100	TYK2(JH2 domain-pseudokinase)	100
BMX	94	DMPK2	100	GCN2 (Kin.Dom.2, S808G)	64	MARK1	100	PDGFRA	88	RIPK2	100	TYRO3	100
BRAF	100	DRAK1	49	GRK1	67	MARK2	81	PDGFRB	60	RIPK4	0.6	ULK1	100
BRAF(V600E)	100	DRAK2	15	GRK2	96	MARK3	86	PDPK1	100	RIPK5	18	ULK2	100
BRK	64	DYRK1A	0.05	GRK3	97	MARK4	100	PFCDPK1 (P.falciparum)	100	ROCK1	100	ULK3	100
BRSK1	100	DYRK1B	0	GRK4	100	MAST1	72	PFPK5 (P.falciparum)	100	ROCK2	100	VEGFR2	73
BRSK2	100	DYRK2	25	GRK7	78	MEK1	86	PFTAIRE2	99	ROS1	22	VPS34	78
BTK	100	EGFR	82	GSK3A	100	MEK2	83	PFTK1	96	RPS6KA4(Kin.Dom. 1-N-terminal)	100	VRK2	100
BUB1	95	EGFR (E746-A750del)	100	GSK3B	83	MEK3	12	PHKG1	1	RPS6KA4(Kin.Dom. 2-C-terminal)	18	WEE1	100

Supplementary Table S2. Continued

Kinase	DNK72 (1 μM)	Kinase	DNK72 (1 μM)	Kinase	DNK72 (1 μM)	Kinase	DNK72 (1 μM)	Kinase	DNK72 (1 μM)	Kinase	DNK72 (1 μM)	Kinase	DNK72 (1 μM)
CAMK1	72	EGFR(G719C)	96	HASPIN	100	MEK4	16	PHKG2	9.3	RPS6KA5(Kin.Dom. 1-N-terminal)	100	WEE2	100
CAMK1B	21	EGFR(G719S)	100	HCK	100	MEK5	74	PIK3C2B	75	RPS6KA5(Kin.Dom. 2-C-terminal)	83	WNK1	100
CAMK1D	66	EGFR (L747-E749del)	97	HIPK1	13	MEK6	92	PIK3C2G	86	RSK1(Kin.Dom. 1-N-terminal)	89	WNK2	100
CAMK1G	94	EGFR (L747-S752del)	100	HIPK2	14	MELK	79	PIK3CA	99	RSK1(Kin.Dom.2-C-terminal)	61	WNK3	100
CAMK2A	39	EGFR(L747-T751del,Sins)	100	HIPK3	16	MERTK	93	PIK3CA (C420R)	91	RSK2(Kin.Dom.1-N-terminal)	100	WNK4	100
CAMK2B	81	EGFR(L858R)	89	HIPK4	45	MET	100	PIK3CA (E542K)	83	RSK2(Kin.Dom.2-C-terminal)	71	YANK1	82
CAMK2D	66	EGFR (L858R,T790M)	55	HPK1	100	MET(M1250T)	100	PIK3CA(E545A)	90	RSK3(Kin.Dom.1-N-terminal)	100	YANK2	100
CAMK2G	80	EGFR(L861Q)	99	HUNK	0.7	MET(Y1235D)	100	PIK3CA(E545K)	90	RSK3(Kin.Dom.2-C-terminal)	66	YANK3	65
CAMK4	27	EGFR (S752-I759del)	100	ICK	96	MINK	91	PIK3CA (H1047L)	88	RSK4(Kin.Dom.1-N-terminal)	95	YES	100
CAMKK1	14	EGFR(T790M)	41	IGF1R	12	MKK7	100	PIK3CA (H1047Y)	96	RSK4(Kin.Dom.2-C-terminal)	97	YSK1	81
CAMKK2	20	EIF2AK1	90	IKK-alpha	93	MKNK1	100	PIK3CA(I800L)	72	S6K1	80	YSK4	94
CASK	100	EPHA1	100	IKK-beta	92	MKNK2	39	PIK3CA (M1043I)	84	SBK1	100	ZAK	100
CDC2L1	99	EPHA2	100	IKK-epsilon	95	MLCK	92	PIK3CA (Q546K)	87	SGK	100	ZAP70	100
CDC2L2	98	EPHA3	92	INSR	7.1	MLK1	66	PIK3CB	92	SgK110	100		