

Department of Pathology- MI-ONCOSEQ OncoSeq Test Definition

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The OncoSeq test covers all or parts of 1,711 genes that have been implicated in cancer. The assay design consists of approximately 4.6 Mb of target sequence including exons of targeted genes as well as regions added for technical reasons. A complete gene list is appended below. Gene names are listed as accessioned during the initial creation of the OncoSeq panel. Updated HGNC validated gene names are listed in parenthesis for names that were identified by <https://www.genenames.org/> to be using a previous symbol on 29-MAR-2019.

The OncoSeq test for somatic mutations covers nonsynonymous somatic single nucleotide variants (SNVs), plus splicing variants (up to 2 bases into an intron) that are present at 5% or greater allelic fraction in the tumor sample. The test also reports variants as low as 1% allelic fraction if the variant exists with sufficient read support. Variants are annotated to RefSeq and reported with respect to the most commonly reported isoform if there are multiple relevant annotations.

OncoSeq validation against Sanger sequencing and externally generated data indicates that the test has above 90% sensitivity for the detection of clonal mutations in samples with at least 20% tumor purity, and above 90% positive predictive value.

In cases where a matched normal sample is unavailable or of unacceptable quality, the OncoSeq test filters by population frequencies instead of presence in the normal sample; this process recovers approximately 97% of the real somatic variants but also calls some private germline variants that cannot be distinguished from somatic mutations.

OncoSeq Gene List (V4):

AATK	CSF1R	GSK3B	MDS2	PRLR	TBX22
ABCA1	CSF2RA	GSTT1	MECOM	PRMT1	TBX3
ABCB1	CSF2RB	GTPBP4	MED12	PRMT2	TBXAS1
ABCB11	CSF3R	GUCY1A2	MED12L	PRMT3	TCEB1 (ELOC)
ABCB4	CSK	H3F3A	MED29	PRMT5	TCF12
ABCC1	CSNK1D	HAX1	MEF2B	PRMT6	TCF3
ABCC2	CSNK1E	HBEGF	MEN1	PRMT7	TCF4
ABCG1	CTCF	HCK	MERTK	PRMT8	TCF7
ABCG2	CTCF	HDAC1	MET	PRPF40B	TCF7L1
ABI1	CTLA4	HDAC10	MGA	PRPF6	TCF7L2
ABL1	CTNNA1	HDAC11	MGMT	PRRX1	TCL1A
ABL2	CTNNA2	HDAC2	MID1	PRRX2	TCL1B

ACE	CTNNA3	HDAC3	MINK1	PRSS1	TEAD1
ACSL6	CTNNB1	HDAC4	MIPOL1	PRSS3	TEAD2
ACTA2	CTNND1	HDAC5	MITF	PRSS8	TEAD3
ACTC1	CTSD	HDAC6	MKL1 (MRTFA)	PSEN1	TEAD4
ACVR1	CTSL	HDAC7	MKL2 (MRTFB)	PSEN2	TEC
ACVR1B	CTSS	HDAC8	MLF1	PSENE1	TEF
ACVR2A	CUL3	HDAC9	MLH1	PSIP1	TEK
ACVR2B	CUL4A	HDGF	MLH3	PSPN	TENM2
ADAM17	CUL4B	HDGFRP3	MLLT1	PTCH1	TERC
ADAMTS20	CUX1	HELLS	MLLT10	PTCH2	TERF1
ADRB1	CYLD	HES1	MLLT11	PTEN	TERT
ADRB2	CYP17A1	HES2	MLLT3	PTGIS	TET1
AFF1	CYP1A2	HES4	MLLT6	PTGS1	TET2
AFF2	CYP21A2	HEY1	MLST8	PTGS2	TET3
AFF3	CYP2A6	HEY2	MN1	PTK2	TFE3
AHR	CYP2B6	HGF	MNX1	PTK2B	TFEB
AIP	CYP2C19	HIF1A	MOB1A	PTK6	TFEC
AJUBA	CYP2C8	HIF1AN	MOB1B	PTK7	TFG
AKAP9	CYP2C9	HIST1H1E	MOS	PTPN11	TGFA
AKT1	CYP2D6	HIST1H3B	MPG	PTPN2	TGFB1
AKT2	CYP2J2	HIST1H4E	MPL	PTPN21	TGFB2
AKT3	CYP2R1	HLF	MRE11A (MRE11)	PTPN6	TGFBR1
ALK	CYP3A4	HLTF	MSH2	PTPRB	TGFBR2
ALKBH6	CYP3A5	HMGA1	MSH3	PTPRC	THPO
ALOX12B	CYP4F2	HMGA2	MSH4	PTPRD	TIE1
ALOX5	DACH1	HMGCR	MSH6	PTPRF	TINF2
AMER1	DACH2	HNF1A	MSI2	PTPRG	TLK1
APC	DAXX	HNF1B	MST1	PTPRJ	TLK2
APEX1	DBH	HNRNPA3	MST1R	PTPRK	TLR1
APH1A	DCC	HOXA10	MTAP	PTPRM	TLR10
APOA1	DCUN1D1	HOXA11	MTCP1	PTPRQ	TLR2
APOB	DCUN1D2	HOXA13	MTDH	PTPRR	TLR4
AR	DDB2	HOXA3	MTOR	PTPRT	TLR5
ARAF	DDIT3	HOXA9	MUSK	PTTG1	TLR6
AREG	DDR1	HOXB13	MUTYH	PVT1	TLR7
ARFRP1	DDR2	HOXB3	MXD1	RAB23	TLR8
ARHGAP10	DDX3X	HOXC10	MYB	RAB25	TLR9
ARHGAP26	DDX5	HOXC11	MYBL1	RABEP1	TLX1
ARHGAP35	DDX6	HOXC13	MYBL2	RAC1	TLX2
ARID1A	DEK	HOXD10	MYBPC3	RAC2	TLX3
ARID1B	DHFR	HOXD11	MYC	RAD21	TMC6
ARID2	DHH	HOXD13	MYCL	RAD50	TMC8
ARID5B	DIAPH1	HOXD3	MYCN	RAD51	TMEM127
ARNT	DIAPH2	HOXD4	MYD88	RAD51AP1	TMEM43
ARNT2	DIAPH3	HR	MYH11	RAD51B	TMPRSS2

ARPC1A	DICER1	HRAS	MYH7	RAD51C	TNFAIP3
ARPC1B	DIRAS3	HSD11B2	MYL2	RAD51D	TNFRSF14
ARTN	DIS3	HSD3B1	MYL3	RAD52	TNFRSF17
ARX	DKC1	HSP90AA1	MYLK	RAD54B	TNK1
ASCL1	DMXL1	HSP90AB1	MYOD1	RAD54L	TNK2
ASCL2	DNM2	HSPBAP1	NAB1	RAF1	TNKS
ASCL3	DNMT1	HTR1A	NAB2	RAP1GDS1	TNKS2
ASCL4	DNMT3A	HTR2A	NAT2	RARA	TNNI3
ASCL5	DNMT3B	ICK	NBN	RARB	TNNT2
ASH1L	DNMT3L	ICOS	NCK1	RARG	TOP1
ASH2L	DOCK2	ICOSLG	NCK2	RASA1	TOP2A
ASPCR1	DOT1L	ID1	NCOA1	RB1	TOP2B
ASXL1	DPYD	ID2	NCOA2	RBM10	TP53
ASXL2	DRD1	ID3	NCOA3	RBM14	TP53BP1
ASXL3	DRD2	ID4	NCOA4	RBM15	TP63
ATAD2	DSC2	IDH1	NCOR1	RBMX	TPM1
ATAD2B	DSG2	IDH2	NCOR2	RBMXL1	TPMT
ATF1	DSP	IFNLR1	NCSTN	RBMXL2	TPTE
ATM	DUSP22	IGF1	NDRG1	RBPJ	TPTE2
ATR	DVL1	IGF1R	NEK1	REC8	TRAF1
ATRX	DVL2	IGF2	NEK10	RECQL4	TRAF2
AURKA	DVL3	IGF2R	NEK11	REL	TRAF3
AURKB	DYRK2	IHH	NEK2	RELA	TRAF3IP1
AURKC	E2F1	IKBIP	NEK3	RELB	TRAF3IP2
AXIN1	E2F3	IKBKAP (ELP1)	NEK4	RET	TRAF3IP3
AXIN2	E2F5	IKBKB	NEK5	RHEB	TRAF6
AXL	E2F6	IKBKE	NEK6	RHOA	TRAF7
B2M	E2F7	IKZF1	NEK7	RHOB	TRIB1
BABAM1	EBF1	IKZF2	NEK8	RHOH	TRIB2
BACH1	ECT2L	IKZF3	NEK9	RHOT1	TRIB3
BACH2	EED	IL10RA	NF1	RICTOR	TRIM24
BAG4	EGF	IL10RB	NF2	RIPK1	TRIM28
BAI3 (ADGRB3)	EGFR	IL11RA	NFATC1	RIPK2	TRIM33
BAP1	EGR1	IL12RB1	NFATC2	RIPK3	TRIM66
BARD1	EGR2	IL12RB2	NFATC3	RIPK4	TRIO
BAX	EHF	IL13RA1	NFATC4	RIT1	TRRAP
BAZ1A	EHMT1	IL15RA	NFE2L2	RNF213	TSC1
BAZ1B	EHMT2	IL17RA	NFIA	RNF40	TSC2
BAZ2A	EIF1AX	IL17RB	NFIB	RNF43	TSHR
BAZ2B	ELANE	IL17RC	NFIC	ROBO2	TSHZ3
BBC3	ELF1	IL18R1	NFIX	ROCK1	TWIST1
BCAR3	ELF2	IL18RAP	NFKB1	ROCK2	TWIST2
BCL10	ELF3	IL1R1	NFKB2	ROR1	TXK
BCL11A	ELF4	IL1R2	NFKBIA	ROR2	TYK2
BCL11B	ELF5	IL1RAP	NFKBIB	ROS1	TYRO3
BCL2	ELK1	IL20RA	NFKBID	RPA1	U2AF1

BCL2A1	ELK3	IL20RB	NFKBIE	RPL5	U2AF2
BCL2L1	ELK4	IL21R	NFKBIZ	RPN1	UBE2D1
BCL2L11	ELP3	IL22RA1	NGF	RPS6KB1	UBE2D2
BCL2L2	EML4	IL22RA2	NHP2	RPS6KB2	UBE2D3
BCL3	EP300	IL23R	NIPBL	RPTOR	UBE2D4
BCL6	EPCAM	IL2RA	NKX2-1	RRM1	UBE4A
BCL7A	EPGN	IL2RB	NKX2-2	RSPO2	UBR5
BCL9	EPHA1	IL2RG	NKX2-3	RSPO3	UGT1A1
BCOR	EPHA2	IL3	NKX2-4	RUNX1	UGT1A4
BCORL1	EPHA3	IL3RA	NKX2-5	RUNX1T1	UHRF1
BCR	EPHA4	IL4R	NKX2-6	RUNX2	UHRF2
BDNF	EPHA5	IL5RA	NKX2-8	RUNX3	USB1
BID	EPHA6	IL6R	NKX3-1	RUVBL1	USP9X
BIRC2	EPHA7	IL6ST	NKX3-2	RXRA	USP9Y
BIRC3	EPHA8	IL7R	NLRP1	RYK	UTY
BIRC5	EPHB1	IL9R	NOD2	RYR1	VAV1
BIRC8	EPHB2	ING1	NONO	RYR2	VAV2
BLK	EPHB3	ING4	NOP10	SAMD9	VAV3
BLM	EPHB4	INHBA	NOTCH1	SAV1	VDR
BLNK	EPHB6	INPP4B	NOTCH2	SBDS	VEGFA
BMI1	EPOR	INSR	NOTCH2NL (NOTCH2NLA)	SCN5A	VEGFB
BMPR1A	ERBB2	INSRR	NOTCH3	SDHA	VEGFC
BMPR1B	ERBB3	INTS12	NOTCH4	SDHAF2	VGLL1
BMX	ERBB4	IQGAP1	NPM1	SDHB	VGLL2
BPTF	ERCC1	IQGAP2	NPPB	SDHC	VGLL3
BRAF	ERCC2	IQGAP3	NPR1	SDHD	VGLL4
BRCA1	ERCC3	IRAK1	NQO1	SET	VHL
BRCA2	ERCC4	IRF4	NROB1	SETBP1	VHLL
BRD1	ERCC5	IRF5	NR3C1	SETD1A	VKORC1
BRD2	EREG	IRF6	NR3C2	SETD1B	VTCN1
BRD3	ERF	IRS1	NR4A1	SETD2	WAPAL (WAPL)
BRD4	ERG	IRS2	NR4A2	SETD3	WAS
BRD7	ESCO1	IRS4	NR4A3	SETD4	WASL
BRD8	ESCO2	ITK	NRAS	SETD5	WHSC1 (NSD2)
BRD9	ESPL1	ITPKB	NRG1	SETD6	WHSC1L1 (NSD3)
BRDT	ESR1	JADE1	NRG2	SETD7	WIF1
BRIP1	ESR2	JAK1	NRG3	SETD8 (KMT5A)	WISP1 (CCN4)
BRPF1	ESRRA	JAK2	NRG4	SETD9	WNK1
BRPF3	ETS1	JAK3	NRIP1	SETDB1	WNK2
BRWD1	ETS2	JARID2	NRTN	SETDB2	WNK3
BRWD3	ETV1	JAZF1	NSD1	SETMAR	WNK4
BTC	ETV2	JMJD1C	NT5C2	SF1	WNT1

BTG1	ETV3	JMJD4	NTF3	SF3A1	WNT10A
BTG2	ETV3L	JMJD6	NTF4	SF3B1	WNT10B
BTG3	ETV4	JMJD7	NTRK1	SFPQ	WNT11
BTK	ETV5	JMJD8	NTRK2	SFRP1	WNT16
BTRC	ETV6	JUN	NTRK3	SGK1	WNT2
BUB1	ETV7	JUNB	NUMB	SGOL1 (SGO1)	WNT2B
BUB1B	EWSR1	JUND	NUMBL	SGOL2 (SGO2)	WNT3
BUB3	EXT1	JUP	NUP214	SH2B3	WNT3A
C11orf30 (EMSY)	EXT2	KAT2A	NUP93	SH2D1A	WNT4
CACNA1C	EXTL1	KAT2B	NUP98	SH3GL1	WNT5A
CACNA1S	EZH1	KAT5	NUTM1	SHB	WNT5B
CACNB2	EZH2	KAT6A	NUTM2A	SHC1	WNT6
CADM2	FADD	KAT6B	NUTM2B	SHC2	WNT7A
CALR	FAM175A (ABRAXAS1)	KAT7	NUTM2F	SHC3	WNT7B
CAMTA1	FAM46C (TENT5C)	KAT8	NUTM2G	SHC4	WNT8A
CAPRIN2	FANCA	KCNH2	ODC1	SHFM1 (SEM1)	WNT8B
CARD10	FANCB	KCNJ5	OLIG2	SHH	WNT9A
CARD11	FANCC	KCNQ1	OSMR	SHOC2	WNT9B
CARD6	FANCD2	KDM1A	PAK1	SKI	WRN
CARD8	FANCE	KDM1B	PAK2	SKIL	WT1
CARM1	FANCF	KDM2A	PAK3	SKOR1	WWTR1
CASC11	FANCG	KDM2B	PAK4	SKP2	XBP1
CASP8	FANCI	KDM3A	PAK6	SLC15A2	XIAP
CBFA2T2	FANCL	KDM3B	PAK7 (PAK5)	SLC19A1	XIRP2
CBFA2T3	FANCM	KDM4A	PALB2	SLC22A1	XPA
CBFB	FAS	KDM4B	PALLD	SLC22A2	XPC
CBL	FASLG	KDM4C	PARK2 (PRKN)	SLC22A3	XPO1
CBLB	FAT1	KDM4D	PARP1	SLC22A6	XRCC2
CBLC	FAT2	KDM5A	PARP2	SLC26A3	YAP1
CBX1	FAT3	KDM5B	PARP4	SLC47A1	YEATS4
CBX2	FAT4	KDM5C	PATZ1	SLC47A2	YES1
CBX3	FBN1	KDM5D	PAX1	SLC6A3	YWHAB
CBX4	FBXO11	KDM6A	PAX2	SLC6A4	YWHAE
CBX5	FBXO8	KDM6B	PAX3	SLCO1A2	YWHAH
CBX6	FBXW11	KDM7A	PAX4	SLCO1B1	YWHAQ
CBX7	FBXW7	KDM8	PAX5	SLCO1B3	YWHAZ
CBX8	FEN1	KDR	PAX6	SLCO2B1	YY1
CCDC6	FER	KDSR	PAX7	SLIT2	ZAP70

CCNB3	FES	KEAP1	PAX8	SLX4	ZBTB16
CCND1	FEV	KEL	PAX9	SMAD1	ZBTB20
CCND2	FGF1	KHSRP	PAXIP1	SMAD2	ZBTB33
CCND3	FGF10	KIAA1804	PBRM1	SMAD3	ZBTB5
CCNE1	FGF11	KIF1B	PBX1	SMAD4	ZBTB7B
CCNE2	FGF12	KIT	PBX2	SMAD5	ZC3H12A
CCNL1	FGF13	KITLG	PBX3	SMAD6	ZC3H12D
CD1D	FGF14	KLF12	PBX4	SMAD7	ZC3H7B
CD22	FGF16	KLF4	PCBP1	SMAD9	ZCCHC7
CD274	FGF17	KLF5	PCSK9	SMARCA1	ZEB2
CD276	FGF18	KLF6	PDCD1	SMARCA2	ZFHX3
CD28	FGF19	KLF8	PDCD1LG2	SMARCA4	ZMYM3
CD40	FGF2	KMT2A	PDGFA	SMARCA5	ZMYND11
CD40LG	FGF20	KMT2B	PDGFB	SMARCB1	ZMYND8
CD44	FGF21	KMT2C	PDGFC	SMARCC1	ZNF217
CD70	FGF22	KMT2D	PDGFD	SMARCD1	ZNF384
CD79A	FGF23	KMT2E	PDGFRA	SMARCD2	ZNF423
CD79B	FGF3	KRAS	PDGFRB	SMARCD3	ZNF444
CD80	FGF4	LATS1	PDK1	SMARCE1	ZNF471
CD86	FGF5	LATS2	PDPK1	SMC1A	ZNF521
CDC14A	FGF6	LCK	PDS5A	SMC1B	ZNF607
CDC20	FGF7	LDB1	PDS5B	SMC2	ZNF639
CDC25A	FGF8	LDLR	PEAR1	SMC3	ZNF668
CDC25B	FGF9	LEF1	PEG3	SMC4	ZNF703
CDC25C	FGFR1	LEPR	PERP	SMC5	ZNF704
CDC42	FGFR2	LGR4	PGF	SMC6	ZNF750
CDC6	FGFR3	LGR5	PGR	SMCHD1	ZNRF3
CDC73	FGFR4	LGR6	PHB	SMO	ZRSR2
CDH1	FGR	LHCGR	PHF1	SMURF1	
CDH10	FH	LIFR	PHF2	SMURF2	
CDH11	FHIT	LMNA	PHF6	SMYD1	
CDH2	FIGF (VEGFD)	LMO1	PHF8	SMYD2	
CDH20	FKBP10	LMO2	PHIP	SMYD3	
CDH3	FKBP5	LMO7	PHLPP1	SMYD4	
CDH5	FKBP9	LMTK2	PHLPP2	SMYD5	
CDH7	FLCN	LMTK3	PHOX2A	SOCS1	
CDK1	FLG	LPHN2 (ADGRL2)	PHOX2B	SOS1	
CDK10	FLI1	LPHN3 (ADGRL3)	PICALM	SOS2	
CDK11A	FLT1	LPP	PIK3C2A	SOX1	
CDK11B	FLT3	LRP1B	PIK3C2B	SOX10	
CDK12	FLT3LG	LRP5	PIK3C2G	SOX17	
CDK13	FLT4	LRP6	PIK3C3	SOX2	
CDK14	FOLH1	LRRK2	PIK3CA	SOX21	
CDK15	FOS	LSM1	PIK3CB	SOX3	
CDK16	FOSB	LTK	PIK3CD	SOX8	

CDK17	FOSL1	LYL1	PIK3CG	SOX9	
CDK18	FOSL2	LYN	PIK3R1	SP100	
CDK19	FOXA1	LZTR1	PIK3R2	SP110	
CDK2	FOXA2	MAD1L1	PIK3R3	SP140	
CDK20	FOXA3	MAD2L1	PIK3R4	SP140L	
CDK3	FOXG1	MAD2L2	PIM1	SP3	
CDK4	FOXL1	MAF	PIM2	SPDEF	
CDK5	FOXL2	MAFB	PIM3	SPEN	
CDK6	FOXM1	MAGED1	PKHD1	SPI1	
CDK7	FOXN3	MAGI2	PKP2	SPIB	
CDK8	FOXO1	MAK	PLA2G2A	SPIC	
CDK9	FOXO3	MALT1	PLAG1	SPOP	
CDKN1A	FOXO4	MAML1	PLAGL1	SPOPL	
CDKN1B	FOXP1	MAML2	PLAGL2	SPRED1	
CDKN1C	FOXP2	MAML3	PLCG1	SPRED2	
CDKN2A	FOXP3	MAMLD1	PLCG2	SPRED3	
CDKN2B	FOXP4	MAOA	PLK1	SPRY2	
CDKN2C	FOXQ1	MAP2K1	PLK2	SPRY3	
CDKN3	FRK	MAP2K2	PLK3	SRC	
CDX1	FRS2	MAP2K3	PLK4	SRGAP3	
CDX2	FRS3	MAP2K4	PMAIP1	SRMS	
CEBPA	FSHR	MAP2K5	PML	SRSF2	
CEBPB	FUBP1	MAP2K6	PMS1	SS18	
CEBPD	FUS	MAP2K7	PMS2	SS18L1	
CEBPE	FYN	MAP3K1	PNRC1	SSTR1	
CEBPG	FZR1	MAP3K10	POLD1	SSTR2	
CEBPZ	G6PC3	MAP3K11	POLE	SSTR3	
CECR2	G6PD	MAP3K12	POR	SSTR4	
CENPE	GAB1	MAP3K13	POT1	SSTR5	
CES1	GAB2	MAP3K14	POU2AF1	SSX1	
CES2	GABPA	MAP3K15	POU2F2	SSX2	
CHD1	GALNT12	MAP3K19	POU5F1	SSX3	
CHD1L	GATA1	MAP3K2	POU5F1B	SSX4	
CHD2	GATA2	MAP3K3	POU5F2	STAG1	
CHD3	GATA3	MAP3K4	POU6F1	STAG2	
CHD4	GATA5	MAP3K5	POU6F2	STARD3	
CHD5	GATA6	MAP3K6	PPARA	STAT1	
CHD6	GDNF	MAP3K7	PPARD	STAT2	
CHD7	GFI1	MAP3K8	PPARG	STAT3	
CHD9	GFI1B	MAP3K9	PPFIA1	STAT4	
CHEK1	GFRA4	MAP4	PPM1D	STAT5A	
CHEK2	GGCX	MAP4K1	PPP1R1C	STAT5B	
CHIC1	GHR	MAP4K2	PPP2R1A	STAT6	
CHIC2	GID4	MAP4K3	PPP2R1B	STK11	
CHUK	GLA	MAP4K4	PPP2R2B	STK19	
CIC	GLCCI1	MAP4K5	PPP6C	STK3	
CIITA	GLI1	MAPK1	PRCC	STK36	
CKS1B	GLI2	MAPK10	PRDM1	STK4	
CKS2	GLI3	MAPK11	PRDM10	STYK1	

CLIP1	GLIS1	MAPK12	PRDM11	SUFU	
CMPK1	GLIS2	MAPK13	PRDM12	SULT1A1	
CNKSRI	GLIS3	MAPK14	PRDM13	SUV39H1	
CNOT3	GNA11	MAPK15	PRDM14	SUV39H2	
CNTFR	GNA13	MAPK3	PRDM15	SUV420H1 (KMT5B)	
COL3A1	GNAQ	MAPK4	PRDM16	SUV420H2 (KMT5C)	
COMT	GNAS	MAPK6	PRDM2	SUZ12	
COPS3	GNRHR	MAPK7	PRDM4	SYK	
CRBN	GOT1	MAPK8	PRDM5	SYNE1	
CREB1	GPC3	MAPK9	PRDM6	TAF1	
CREB3L1	GPC5	MARCH1	PRDM7	TAF15	
CREB3L2	GPR124 (ADGRA2)	MAST1	PRDM8	TAF1L	
CREB3L4	GPS2	MAST2	PRDM9	TAL1	
CREBBP	GRB10	MATK	PREX2	TAL2	
CREM	GRB2	MAU2	PRF1	TAOK1	
CRHR1	GRB7	MAX	PRKACA	TAOK2	
CRK	GREM1	MBD1	PRKACB	TAOK3	
CRKL	GRIN2A	MBD3	PRKAG2	TBC1D12	
CRLF2	GRK4	MC1R	PRKAR1A	TBL1X	
CRTC1	GRK5	MCL1	PRKAR1B	TBL1XR1	
CRTC2	GRM3	MCPH1	PRKCI	TBP	
CRTC3	GRM8	MDM2	PRKD1	TBX18	
CSF1	GSK3A	MDM4	PRKDC	TBX2	