

Global proteome analysis of glioblastoma stem cells by high-resolution mass spectrometry

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ABSTRACT

Glioblastoma is known as a highly lethal brain tumor and shows resistance to both chemotherapeutic treatment and radiation. In order to obtain an overview of the molecular networks related to this malignancy, we applied a shotgun proteomics approach to characterize the expression status of the glioblastoma proteome. As a result, a total of 2,089 proteins were identified from human glioblastoma stem cells using high-resolution mass spectrometry. Gene ontology classification based on Human Protein Reference Database (HPRD) revealed that they were localized in various compartments such as cytoplasm, nucleus and plasma membrane (37%, 30% and 8%, respectively). The proteins associated with signal transduction, regulation of nucleic acid metabolism, protein metabolism and metabolism/energy pathways showed similar proportions (about 16%) in terms of biological processes. Furthermore, the bioinformatics analysis using Database for Annotation, Visualization and Integrated Discovery (DAVID) software uncovered a variety of pathways concerning cancer and cancer stem-like cells such as glycolysis, pyruvate metabolism and pentose phosphate pathway. Intriguingly, our global proteome analysis also revealed an enriched fraction of proteins related to ribosome,

spliceosome and proteasome machineries. Our results provide a new insight into the protein networks in glioblastoma stem cells and pave the way for exploration of drug targets to develop more effective treatments for glioblastoma.

KEYWORDS: cancer stem cells, gene ontology, glioblastoma, nanoLC-MS/MS, proteomics

ABBREVIATIONS

nanoLC-MS/MS, nanoflow liquid chromatography-tandem mass spectrometry; FACS, fluorescence-activated cell sorting; CID, collision induced dissociation; FDR, false discovery rate; HPRD, Human Protein Reference Database; DAVID, Database for Annotation, Visualization and Integrated Discovery; EMT, epithelial-mesenchymal transition; EndMT, endothelial-mesenchymal transition

INTRODUCTION

Glioblastoma is well known to be one of the most aggressive brain tumors with poor prognosis. Even maximal treatment allows patients a median survival time of only 15 months [1]. Some recent studies demonstrated the existence of a slight portion of stem cells in glioblastoma [2-6], which have properties similar to somatic stem cells, such as self-renewal and multi-differentiation. Moreover, they are considered to play a pivotal role in cancer recurrence and resistance to drug or

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radiotherapy [7-9]. Although considerable researches have been conducted regarding glioblastoma so far, the comprehensive status of protein networks and pathways in glioblastoma stem cells remains unclear.

Recently established nanoflow liquid chromatography-tandem mass spectrometry (nanoLC-MS/MS) technology enables us to identify thousands of proteins in a single project [10, 11]. Based on this highly sophisticated system, we can elucidate various biological events related to protein networks in a comprehensive manner [12]. Very recently, this shotgun proteomics technology has also been applied to stem cells [13-15] and cancer stem cells [16-18].

Therefore, in order to elucidate the molecular networks correlated with the properties of glioblastoma stem cells, we applied a high resolution mass spectrometry-based proteomics technology to characterize the comprehensive status of the expressed proteome. As a result, a total of 2,089 proteins were identified with high confidence including stemness/glioma-related molecules such as transcription factor SOX-2 (SOX2) [19], nestin (NES) [20] and pyruvate kinase isozymes M1/M2 (PKM2) [21]. We further performed gene ontology and pathway analyses to characterize functional compartments enriched in glioblastoma stem cells, leading to identification of several pathways concerning cancer and cancer stem-like cells in addition to large functional complexes such as ribosome, spliceosome and proteasome machineries.

Our comprehensive description of the glioblastoma proteome will lead us to explore for molecular targets towards effective medical treatment at the system level.

MATERIALS AND METHODS

Cell culture

Glioblastoma stem cells were originally established from the glioblastoma brain tissues in the University of Tokyo Hospital based on the written informed consent to undertake genetic and molecular analyses from the patients. The fluorescence-activated cell sorting (FACS) analysis showed that the CD15-positive rate of the

glioblastoma cells was 12% [22]. The cells were cultured in Dulbecco's modified Eagle's medium: Nutrient Mixture F-12 (DMEM/F12) media (Pierce) with 2% B27 supplement minus vitamin A, 20 ng/ml EGF (Upstate Biotechnology) and 20 ng/ml fibroblast growth factor (FGF) (Roche) as previously described [23]. The cells were washed three times with PBS, harvested, and suspended in 8 M urea containing Benzamide (Novagen). After the mixture was kept left on ice for 1 h, cellular debris was pelleted by centrifugation at 15,000 rpm for 30 min. The lysate was quantified using BCA Protein Assay Kit (Thermo Scientific).

Sample preparation

The lysate was reduced with 1 mM dithiothreitol (DTT) for 90 min, and subsequently alkylated with 5.5 mM iodoacetamide (IAA) for 30 min. After digestion with Lysyl Endopeptidase (Lys-C) (1:50 w/w) (Wako) at 37°C for 3 h, the resulting peptide mixture was diluted with 10 mM Tris-HCl (pH 8.2) to achieve final concentration below 2 M Urea and subsequently digested with modified trypsin (1:50 w/w) (Sequencing grade, Promega) at 37°C for 3 h. An equal amount of trypsin was then added once more for overnight digestion. The peptide samples were desalted using ZipTip C₁₈ (Millipore) and centrifuged by vacuum concentrator.

Mass spectrometric analysis

Shotgun proteomic analysis of the digested samples was performed by a linear ion trap-orbitrap mass spectrometer (LTQ-Orbitrap Velos, Thermo Fisher Scientific) coupled with nanoflow LC system (Dina-2A, KYA Technologies). Peptides were injected into 75 µm reversed-phase C₁₈ column at a flow rate of 10 µl/min and eluted with a linear gradient of solvent A (2% acetonitrile and 0.1% formic acid in H₂O) to solvent B (40% acetonitrile and 0.1% formic acid in H₂O) at 300 nl/min. Peptides were sequentially sprayed from nanoelectrospray ion source (KYA Technologies) and analyzed by collision induced dissociation (CID). The analyses were operated in data dependent mode, switching automatically between MS and MS/MS acquisition. For CID analyses, full-scan MS spectra (from m/z 380 to

2,000) were acquired in the orbitrap with resolution of 100,000 at m/z 400 after ion count accumulation to the target value of 1,000,000. The 20 most intense ions at a threshold above 2,000 were fragmented in the linear ion trap with normalized collision energy of 35% for activation time of 10 ms. The orbitrap analyzer was operated with the “lock mass” option to perform shotgun detection with high accuracy [24].

Protein identification

Protein identification was conducted by searching against the RefSeq (National Center for Biotechnology Information) human protein database (32,968 protein sequences as of Sep 12, 2011) using Mascot ver. 2.3.02 (Matrix Science). A maximum of two missed cleavages were considered in our database search. The maximally allowed mass deviation was set to 3 parts per million (ppm) for peptide masses and 0.8 Da for MS/MS peaks. The false discovery rate (FDR) was determined as $< 1\%$ through the decoy database-based statistical evaluation.

RESULTS AND DISCUSSION

Large-scale identification of the proteins expressed in glioblastoma stem cells

In order to comprehensively characterize proteins in glioblastoma stem cells, we performed a high-resolution shotgun proteome analysis using nanoLC-MS/MS system. Consequently, we identified 8,896 unique peptides derived from 2,089 proteins including a variety of proteins with stemness properties such as transcription factor SOX-2 (SOX2) [19], FACT complex subunit SSRP1 (SSRP1) [25], microtubule-associated protein2 (MAP2) [26], nestin (NES) [20] and vimentin (VIM) [27] (Table 1).

Furthermore, other proteins with features of glioma such as Annexin A1 (ANXA1), pyruvate kinase isozymes M1/M2 (PKM2), LIM and SH3 domain protein 1 (LASP1) and glutathione S-transferase P (GSTP1) were also identified in our in-depth proteomic analysis. ANXA1 is a potent inhibitor of phospholipase A2, thus promoting the anti-inflammatory effect of glucocorticoids [28].

Table 1. List of the proteins identified in the global proteome analysis of glioblastoma stem cells.

RefSeq ID	Description	Gene symbol
NP_002148.1	10 kDa heat shock protein, mitochondrial	HSPE1
NP_001136077.1	116 kDa U5 small nuclear ribonucleoprotein component isoform b	EFTUD2
NP_054891.2	14 kDa phosphohistidine phosphatase isoform 3	PHPT1
NP_647539.1	14-3-3 protein beta/alpha	YWHAH
NP_006752.1	14-3-3 protein epsilon	YWHAE
NP_003396.1	14-3-3 protein eta	YWHAH
NP_036611.2	14-3-3 protein gamma	YWHAG
NP_006817.1	14-3-3 protein theta	YWHAQ
NP_003397.1	14-3-3 protein zeta/delta	YWHAZ
NP_001171812.1	1-phosphatidylinositol-4,5-bisphosphate phosphodiesterase beta-3 isoform 2	PLCB3
NP_877963.1	1-phosphatidylinositol-4,5-bisphosphate phosphodiesterase gamma-1 isoform b	PLCG1
NP_149124.3	2',3'-cyclic-nucleotide 3'-phosphodiesterase	CNP
NP_001350.1	2,4-dienoyl-CoA reductase, mitochondrial precursor	DECR1
NP_002797.3	26S protease regulatory subunit 10B	PSMC6
NP_002793.2	26S protease regulatory subunit 4	PSMC1
NP_002795.2	26S protease regulatory subunit 6A	PSMC3
NP_694546.1	26S protease regulatory subunit 6B isoform 2	PSMC4
NP_002794.1	26S protease regulatory subunit 7 isoform 1	PSMC2
NP_001186092.1	26S protease regulatory subunit 8 isoform 2	PSMC5
NP_001177966.1	26S proteasome non-ATPase regulatory subunit 1 isoform 2	PSMD1
NP_002805.1	26S proteasome non-ATPase regulatory subunit 10 isoform 1	PSMD10
NP_002806.2	26S proteasome non-ATPase regulatory subunit 11	PSMD11
NP_002807.1	26S proteasome non-ATPase regulatory subunit 12 isoform 1	PSMD12
NP_002808.3	26S proteasome non-ATPase regulatory subunit 13 isoform 1	PSMD13
NP_005796.1	26S proteasome non-ATPase regulatory subunit 14	PSMD14

Table 1 continued..

NP_002799.3	26S proteasome non-ATPase regulatory subunit 2	PSMD2
NP_002800.2	26S proteasome non-ATPase regulatory subunit 3	PSMD3
NP_002801.1	26S proteasome non-ATPase regulatory subunit 4	PSMD4
NP_005038.1	26S proteasome non-ATPase regulatory subunit 5	PSMD5
NP_055629.1	26S proteasome non-ATPase regulatory subunit 6	PSMD6
NP_002802.2	26S proteasome non-ATPase regulatory subunit 7	PSMD7
NP_002803.2	26S proteasome non-ATPase regulatory subunit 8	PSMD8
NP_002804.2	26S proteasome non-ATPase regulatory subunit 9	PSMD9
NP_055706.1	28 kDa heat- and acid-stable phosphoprotein	PDAP1
NP_055899.2	28S ribosomal protein S27, mitochondrial	MRPS27
NP_115865.1	28S ribosomal protein S6, mitochondrial	MRPS6
NP_006076.4	3'(2'),5'-bisphosphate nucleotidase 1	BPNT1
NP_660298.2	39S ribosomal protein L10, mitochondrial isoform a precursor	MRPL10
NP_002940.2	39S ribosomal protein L12, mitochondrial precursor	MRPL12
NP_006570.1	3-beta-hydroxysteroid-Delta(8),Delta(7)-isomerase	EBP
NP_057479.2	3-hydroxyacyl-CoA dehydratase 3	PTPLAD1
NP_004484.1	3-hydroxyacyl-CoA dehydrogenase type-2 isoform 1	HSD17B10
NP_689953.1	3-hydroxyisobutyrate dehydrogenase, mitochondrial precursor	HIBADH
NP_001598.1	3-ketoacyl-CoA thiolase, peroxisomal isoform a	ACAA1
NP_001123989.1	3-mercaptopyruvate sulfurtransferase isoform 2	MPST
NP_001006.1	40S ribosomal protein S11	RPS11
NP_001007.2	40S ribosomal protein S12	RPS12
NP_001008.1	40S ribosomal protein S13	RPS13
NP_005608.1	40S ribosomal protein S14	RPS14
NP_001009.1	40S ribosomal protein S15	RPS15
NP_001010.2	40S ribosomal protein S15a	RPS15A
NP_001011.1	40S ribosomal protein S16	RPS16
NP_001185986.1	40S ribosomal protein S17-like	RPS17L
NP_072045.1	40S ribosomal protein S18	RPS18
NP_001013.1	40S ribosomal protein S19	RPS19
NP_002943.2	40S ribosomal protein S2	RPS2
NP_001014.1	40S ribosomal protein S20 isoform 2	RPS20
NP_001015.1	40S ribosomal protein S21	RPS21
NP_001016.1	40S ribosomal protein S23	RPS23
NP_148982.1	40S ribosomal protein S24 isoform a	RPS24
NP_001019.1	40S ribosomal protein S25	RPS25
NP_001020.2	40S ribosomal protein S26	RPS26
NP_001021.1	40S ribosomal protein S27	RPS27
NP_001022.1	40S ribosomal protein S28	RPS28
NP_001023.1	40S ribosomal protein S29 isoform 1	RPS29
NP_000996.2	40S ribosomal protein S3	RPS3
NP_000997.1	40S ribosomal protein S3a	RPS3A
NP_000998.1	40S ribosomal protein S4, X isoform X isoform	RPS4X
NP_001000.2	40S ribosomal protein S5	RPS5
NP_001001.2	40S ribosomal protein S6	RPS6
NP_001002.1	40S ribosomal protein S7	RPS7
NP_001003.1	40S ribosomal protein S8	RPS8
NP_001004.2	40S ribosomal protein S9	RPS9
NP_001012321.1	40S ribosomal protein SA	RPSA
NP_065737.2	4-aminobutyrate aminotransferase, mitochondrial precursor	ABAT
NP_001013269.1	4F2 cell-surface antigen heavy chain isoform f	SLC3A2
NP_000687.3	4-trimethylaminobutyraldehyde dehydrogenase	ALDH9A1
NP_055410.1	5'(3')-deoxyribonucleotidase, cytosolic type	NT5C
NP_036387.2	5'-3' exoribonuclease 2	XRN2
NP_006243.2	5'-AMP-activated protein kinase catalytic subunit alpha-2	PRKAA2

Table 1 continued..

NP_075059.1	5'-nucleotidase domain-containing protein 2 isoform 2	NT5DC2
NP_002147.2	60 kDa heat shock protein, mitochondrial	HSPD1
NP_001166996.1	60 kDa SS-A/Ro ribonucleoprotein isoform 4	TROVE2
NP_444505.1	60S acidic ribosomal protein P0	RPLP0
NP_000994.1	60S acidic ribosomal protein P1 isoform 1	RPLP1
NP_000995.1	60S acidic ribosomal protein P2	RPLP2
NP_006004.2	60S ribosomal protein L10	RPL10
NP_009035.3	60S ribosomal protein L10a	RPL10A
NP_001186731.1	60S ribosomal protein L11 isoform 2	RPL11
NP_000967.1	60S ribosomal protein L12	RPL12
NP_001230059.1	60S ribosomal protein L13 isoform 2	RPL13
NP_036555.1	60S ribosomal protein L13a	RPL13A
NP_003964.3	60S ribosomal protein L14	RPL14
NP_002939.2	60S ribosomal protein L15	RPL15
NP_000976.1	60S ribosomal protein L17 isoform a	RPL17
NP_000970.1	60S ribosomal protein L18	RPL18
NP_000971.1	60S ribosomal protein L18a	RPL18A
NP_000972.1	60S ribosomal protein L19	RPL19
NP_000973.2	60S ribosomal protein L21	RPL21
NP_000974.1	60S ribosomal protein L22 proprotein	RPL22
NP_000969.1	60S ribosomal protein L23	RPL23
NP_000975.2	60S ribosomal protein L23a	RPL23A
NP_000977.1	60S ribosomal protein L24	RPL24
NP_000978.1	60S ribosomal protein L26	RPL26
NP_000979.1	60S ribosomal protein L27	RPL27
NP_000981.1	60S ribosomal protein L27a	RPL27A
NP_001129609.1	60S ribosomal protein L28 isoform 5	RPL28
NP_000983.1	60S ribosomal protein L29	RPL29
NP_001029025.1	60S ribosomal protein L3 isoform b	RPL3
NP_000980.1	60S ribosomal protein L30	RPL30
NP_001093163.1	60S ribosomal protein L31 isoform 3	RPL31
NP_000985.1	60S ribosomal protein L32	RPL32
NP_000986.2	60S ribosomal protein L34	RPL34
NP_009140.1	60S ribosomal protein L35	RPL35
NP_378669.1	60S ribosomal protein L36	RPL36
NP_000959.2	60S ribosomal protein L4	RPL4
NP_000960.2	60S ribosomal protein L5	RPL5
NP_000961.2	60S ribosomal protein L6	RPL6
NP_000962.2	60S ribosomal protein L7	RPL7
NP_000963.1	60S ribosomal protein L7a	RPL7A
NP_940888.2	60S ribosomal protein L7-like 1	RPL7L1
NP_150644.1	60S ribosomal protein L8	RPL8
NP_001020092.1	60S ribosomal protein L9	RPL9
NP_002618.1	6-phosphofructokinase type C isoform 1	PFKP
NP_002617.3	6-phosphofructokinase, liver type	PFKL
NP_000280.1	6-phosphofructokinase, muscle type isoform 2	PFKM
NP_002622.2	6-phosphogluconate dehydrogenase, decarboxylating	PGD
NP_036220.1	6-phosphogluconolactonase	PGLS
NP_002443.3	7,8-dihydro-8-oxoguanine triphosphatase isoform p18	NUDT1
NP_005338.1	78 kDa glucose-regulated protein precursor	HSPA5
NP_001351.2	7-dehydrocholesterol reductase	DHCR7
NP_062552.2	7SK snRNA methylphosphate capping enzyme isoform A	MEPCE
NP_001138836.1	abhydrolase domain-containing protein 11 isoform 8	ABHD11
NP_001171596.1	abl interactor 1 isoform 1	ABI1
NP_005882.2	acetyl-CoA acetyltransferase, cytosolic	ACAT2

Table 1 continued..

NP_000010.1	acetyl-CoA acetyltransferase, mitochondrial precursor	ACAT1
NP_942135.1	acetyl-CoA carboxylase 1 isoform 4	ACACA
NP_001229322.1	acetyl-coenzyme A synthetase, cytoplasmic isoform 3	ACSS2
NP_808592.2	acid ceramidase isoform a preproprotein	ASAH1
NP_006296.1	acidic leucine-rich nuclear phosphoprotein 32 family member A	ANP32A
NP_006392.1	acidic leucine-rich nuclear phosphoprotein 32 family member B	ANP32B
NP_112182.1	acidic leucine-rich nuclear phosphoprotein 32 family member E isoform 1	ANP32E
NP_001089.1	aconitate hydratase, mitochondrial precursor	ACO2
NP_005150.1	actin, alpha cardiac muscle 1 proprotein	ACTC1
NP_001092.1	actin, cytoplasmic 1	ACTB
NP_001605.1	actin, cytoplasmic 2	ACTG1
NP_817126.1	actin-like protein 6A isoform 2	ACTL6A
NP_005713.1	actin-related protein 2 isoform b	ACTR2
NP_006400.2	actin-related protein 2/3 complex subunit 1A isoform 1	ARPC1A
NP_005711.1	actin-related protein 2/3 complex subunit 1B	ARPC1B
NP_690601.1	actin-related protein 2/3 complex subunit 2	ARPC2
NP_005710.1	actin-related protein 2/3 complex subunit 3	ARPC3
NP_005709.1	actin-related protein 2/3 complex subunit 4 isoform a	ARPC4
NP_005708.1	actin-related protein 2/3 complex subunit 5	ARPC5
NP_112240.1	actin-related protein 2/3 complex subunit 5-like protein	ARPC5L
NP_005712.1	actin-related protein 3	ACTR3
NP_006704.3	activated RNA polymerase II transcriptional coactivator p15	SUB1
NP_006819.2	activating signal cointegrator 1 complex subunit 3 isoform a	ASCC3
NP_036243.1	activator of 90 kDa heat shock protein ATPase homolog 1	AHSA1
NP_004994.1	acyl carrier protein, mitochondrial precursor	NDUFAB1
NP_001631.3	acylamino-acid-releasing enzyme	APEH
NP_115545.3	acyl-CoA dehydrogenase family member 11	ACAD11
NP_054768.2	acyl-CoA dehydrogenase family member 9, mitochondrial precursor	ACAD9
NP_005054.3	acyl-CoA desaturase	SCD
NP_861522.2	acyl-CoA synthetase family member 4	AASDH
NP_001073331.1	acyl-CoA-binding protein isoform 3	DBI
NP_006321.1	acyl-protein thioesterase 1	LYPLA1
NP_009191.1	acyl-protein thioesterase 2	LYPLA2
NP_005197.3	adapter molecule crk isoform b	CRK
NP_000476.1	adenine phosphoribosyltransferase isoform a	APRT
NP_000013.2	adenosine deaminase	ADA
NP_001189379.1	adenosine kinase isoform d	ADK
NP_000678.1	adenosylhomocysteinase isoform 1	AHCY
NP_001186128.1	adenylate kinase 2, mitochondrial isoform c	AK2
NP_000467.1	adenylate kinase isoenzyme 1	AK1
NP_001116850.1	adenylosuccinate lyase isoform b	ADSL
NP_001117.2	adenylosuccinate synthetase isozyme 2	ADSS
NP_006358.1	adenylyl cyclase-associated protein 1	CAP1
NP_006357.1	adenylyl cyclase-associated protein 2	CAP2
NP_065392.1	adipocyte plasma membrane-associated protein	C20orf3
NP_001143.2	ADP/ATP translocase 2	SLC25A5
NP_001649.1	ADP-ribosylation factor 1	ARF1
NP_001651.1	ADP-ribosylation factor 4	ARF4
NP_001653.1	ADP-ribosylation factor 5	ARF5
NP_001229761.1	ADP-ribosylation factor GTPase-activating protein 2 isoform 2	ARFGAP2
NP_001168.1	ADP-ribosylation factor-like protein 1	ARL1
NP_004302.1	ADP-ribosylation factor-like protein 3	ARL3
NP_055976.1	ADP-ribosylation factor-like protein 6-interacting protein 1	ARL6IP1
NP_620150.1	ADP-ribosylation factor-like protein 8A	ARL8A
NP_054861.2	ADP-sugar pyrophosphatase	NUDT5

Table 1 continued..

NP_006567.3	advillin	AVIL
NP_001193937.1	afadin isoform 1	MLLT4
NP_003680.2	aflatoxin B1 aldehyde reductase member 2	AKR7A2
NP_003968.2	AH receptor-interacting protein	AIP
NP_653080.1	A-kinase anchor protein 12 isoform 2	AKAP12
NP_005849.1	A-kinase anchor protein 8	AKAP8
NP_001596.2	alanyl-tRNA synthetase, cytoplasmic	AARS
NP_697021.1	alcohol dehydrogenase [NADP+]	AKR1A1
NP_000662.3	alcohol dehydrogenase class-3	ADH5
NP_001138868.1	aldehyde dehydrogenase family 16 member A1 isoform 2	ALDH16A1
NP_001619.1	aldose reductase	AKR1B1
NP_003650.1	alkyldihydroxyacetonephosphate synthase, peroxisomal precursor	AGPS
NP_001172025.1	allograft inflammatory factor 1-like isoform 4	AIF1L
NP_054783.2	alpha N-terminal protein methyltransferase 1A	METTL11A
NP_002328.1	alpha-2-macroglobulin receptor-associated protein precursor	LRPAP1
NP_001123477.1	alpha-actinin-1 isoform c	ACTN1
NP_004915.2	alpha-actinin-4	ACTN4
NP_054909.2	alpha-adducin isoform c	ADD1
NP_005727.1	alpha-centractin	ACTR1A
NP_001876.1	alpha-crystallin B chain	CRYAB
NP_996930.1	alpha-endosulfine isoform 7	ENSA
NP_001419.1	alpha-enolase isoform 1	ENO1
NP_116116.1	alpha-internexin	INA
NP_060692.2	alpha-parvin	PARVA
NP_003818.2	alpha-soluble NSF attachment protein	NAPA
NP_787048.1	alpha-taxilin	TXLNA
NP_006197.1	alpha-type platelet-derived growth factor receptor precursor	PDGFRA
NP_004748.2	aminoacyl tRNA synthase complex-interacting multifunctional protein 1 isoform a precursor	AIMP1
NP_006294.2	aminoacyl tRNA synthase complex-interacting multifunctional protein 2	AIMP2
NP_001129602.1	amyloid beta A4 protein isoform f precursor	APP
NP_001135748.1	amyloid-like protein 2 isoform 2 precursor	APLP2
NP_064709.2	anamorsin	CIAPIN1
NP_057460.3	ankyrin repeat and FYVE domain-containing protein 1 isoform 1	ANKFY1
NP_057636.2	ankyrin repeat and MYND domain-containing protein 1 isoform 1	ANKMY1
NP_065210.2	ankyrin-1 isoform 2	ANK1
NP_001120965.1	ankyrin-2 isoform 3	ANK2
NP_000691.1	annexin A1	ANXA1
NP_001129487.1	annexin A2 isoform 2	ANXA2
NP_001144.1	annexin A4	ANXA4
NP_001145.1	annexin A5	ANXA5
NP_001146.2	annexin A6 isoform 1	ANXA6
NP_001147.1	annexin A7 isoform 1	ANXA7
NP_001159491.1	AP-1 complex subunit beta-1 isoform c	AP1B1
NP_001119.3	AP-1 complex subunit gamma-1 isoform b	AP1G1
NP_115882.1	AP-1 complex subunit mu-1 isoform 2	AP1M1
NP_570603.2	AP-2 complex subunit alpha-1 isoform 2	AP2A1
NP_036437.1	AP-2 complex subunit alpha-2 isoform 2	AP2A2
NP_001273.1	AP-2 complex subunit beta isoform b	AP2B1
NP_001020376.1	AP-2 complex subunit mu isoform b	AP2M1
NP_067586.1	AP-2 complex subunit sigma isoform AP17delta	AP2S1
NP_003655.3	AP-3 complex subunit beta-1	AP3B1
NP_003929.4	AP-3 complex subunit delta-1 isoform 2	AP3D1
NP_996895.1	AP-3 complex subunit mu-1	AP3M1
NP_658985.2	apolipoprotein A-I-binding protein precursor	APOA1BP
NP_663612.1	apolipoprotein L2	APOL2

Table 1 continued..

NP_006586.1	apoptosis inhibitor 5 isoform b	API5
NP_620119.2	apoptosis regulator BAX isoform sigma	BAX
NP_001124319.1	apoptosis-inducing factor 1, mitochondrial isoform 5 precursor	AIFM1
NP_001158287.1	apoptotic chromatin condensation inducer in the nucleus isoform 3	ACIN1
NP_054749.2	ARF GTPase-activating protein GIT1 isoform 2	GIT1
NP_476511.1	ARF GTPase-activating protein GIT2 isoform 2	GIT2
NP_001128661.1	arf-GAP domain and FG repeats-containing protein 1 isoform 4	AGFG1
NP_002878.2	arginyl-tRNA synthetase, cytoplasmic	RARS
NP_001661.1	armadillo repeat protein deleted in velo-cardio-facial syndrome	ARVCF
NP_060590.1	armadillo repeat-containing protein 1	ARMC1
NP_056211.2	armadillo repeat-containing protein 8 isoform 2	ARMC8
NP_001171546.1	asparagine synthetase [glutamine-hydrolyzing] isoform b	ASNS
NP_004530.1	asparaginyl-tRNA synthetase, cytoplasmic	NARS
NP_002070.1	aspartate aminotransferase, cytoplasmic	GOT1
NP_002071.2	aspartate aminotransferase, mitochondrial precursor	GOT2
NP_036232.2	aspartyl aminopeptidase	DNPEP
NP_001158228.1	aspartyl/asparaginyl beta-hydroxylase isoform 1	ASPH
NP_001340.2	aspartyl-tRNA synthetase, cytoplasmic	DARS
NP_003759.1	astrocytic phosphoprotein PEA-15	PEA15
NP_001161093.1	ataxin-10 isoform 2	ATXN10
NP_680781.1	ataxin-2-like protein isoform D	ATXN2L
NP_056274.3	atlastin-3	ATL3
NP_004037.1	ATP synthase subunit alpha, mitochondrial precursor	ATP5A1
NP_001677.2	ATP synthase subunit beta, mitochondrial precursor	ATP5B
NP_005165.1	ATP synthase subunit gamma, mitochondrial isoform H (heart) precursor	ATP5C1
NP_001688.1	ATP synthase subunit O, mitochondrial precursor	ATP5O
NP_001676.2	ATP synthase-coupling factor 6, mitochondrial isoform a precursor	ATP5J
NP_004308.2	ATPase ASNA1	ASNA1
NP_054828.2	ATPase family AAA domain-containing protein 2	ATAD2
NP_848654.3	ATP-binding cassette sub-family B member 5 isoform 2	ABCB5
NP_000343.2	ATP-binding cassette sub-family C member 8	ABCC8
NP_002849.1	ATP-binding cassette sub-family D member 3 isoform a	ABCD3
NP_002931.2	ATP-binding cassette sub-family E member 1	ABCE1
NP_001081.1	ATP-binding cassette sub-family F member 1 isoform b	ABCF1
NP_942127.1	ATP-citrate synthase isoform 2	ACLY
NP_002898.2	ATP-dependent DNA helicase Q1	RECQL
NP_001348.2	ATP-dependent RNA helicase A	DHX9
NP_004930.1	ATP-dependent RNA helicase DDX1	DDX1
NP_005795.2	ATP-dependent RNA helicase DDX39A	DDX39A
NP_001180346.1	ATP-dependent RNA helicase DDX3X isoform 3	DDX3X
NP_031398.2	ATP-dependent RNA helicase DDX42	DDX42
NP_055085.1	B(0,+)-type amino acid transporter 1	SLC7A9
NP_056496.1	B9 domain-containing protein 1 isoform b	B9D1
NP_004273.1	BAG family molecular chaperone regulator 2	BAG2
NP_001015048.1	BAG family molecular chaperone regulator 5 isoform b	BAG5
NP_001171866.1	band 4.1-like protein 5 isoform 2	EPB41L5
NP_001193996.1	basic leucine zipper and W2 domain-containing protein 1 isoform 1	BZW1
NP_054757.1	basic leucine zipper and W2 domain-containing protein 2	BZW2
NP_940993.1	basigin isoform 4	BSG
NP_001070908.1	bcl-2-associated transcription factor 1 isoform 2	BCLAF1
NP_612815.1	bcl-2-like protein 1 isoform 1	BCL2L1
NP_056182.2	bcl-2-like protein 13	BCL2L13
NP_004039.1	beta-2-microglobulin precursor	B2M
NP_001017992.1	beta-actin-like protein 2	ACTBL2
NP_110517.2	beta-catenin-like protein 1	CTNBL1

Table 1 continued..

NP_612351.2	beta-galactosidase-1-like protein 2 precursor	GLB1L2
NP_057111.1	beta-lactamase-like protein 2	LACTB2
NP_001187.1	BH3-interacting domain death agonist isoform 2	BID
NP_005434.4	bifunctional 3'-phosphoadenosine 5'-phosphosulfate synthase 1	PAPSS1
NP_004437.2	bifunctional aminoacyl-tRNA synthetase	EPRS
NP_036347.1	bifunctional protein NCOAT isoform a	MGEA5
NP_004035.2	bifunctional purine biosynthesis protein PURH	ATIC
NP_001177313.1	bifunctional UDP-N-acetylglucosamine 2-epimerase/N-acetylmannosamine kinase isoform 5	GNE
NP_000703.2	biliverdin reductase A precursor	BLVRA
NP_001152.1	bis(5'-nucleosyl)-tetrphosphatase [asymmetrical]	NUDT2
NP_954655.1	bisphosphoglycerate mutase	BPGM
NP_000377.1	bleomycin hydrolase	BLMH
NP_000048.1	Bloom syndrome protein	BLM
NP_001026997.1	BolA-like protein 2	BOLA2
NP_006331.1	brain-specific angiogenesis inhibitor 1-associated protein 2 isoform 3	BAIAP2
NP_001171563.1	branched-chain-amino-acid aminotransferase, cytosolic isoform 3	BCAT1
NP_689956.2	BRCA1-associated ATM activator 1	BRAT1
NP_510869.1	BRCA2 and CDKN1A-interacting protein isoform C	BCCIP
NP_001164192.1	breast cancer anti-estrogen resistance protein 1 isoform 9	BCAR1
NP_000050.2	breast cancer type 2 susceptibility protein	BRCA2
NP_006411.2	brefeldin A-inhibited guanine nucleotide-exchange protein 2	ARFGEF2
NP_068767.3	brevican core protein isoform 1	BCAN
NP_056363.2	bullous pemphigoid antigen 1 isoform 1eA precursor	DST
NP_005947.3	C-1-tetrahydrofolate synthase, cytoplasmic	MTHFD1
NP_005848.2	CAAX prenyl protease 1 homolog	ZMPSTE24
NP_004332.2	CAD protein	CAD
NP_001783.2	cadherin-2 preproprotein	CDH2
NP_001188358.1	calcineurin-binding protein cabin-1 isoform b	CABIN1
NP_006374.1	calcium and integrin-binding family member 2	CIB2
NP_742125.1	calcium/calmodulin-dependent protein kinase type II subunit delta isoform 1	CAMK2D
NP_112187.2	calcium-binding protein 39-like	CAB39L
NP_055131.2	calcium-regulated heat stable protein 1	CARHSP1
NP_001007215.1	calcyclin-binding protein isoform 2	CACYBP
NP_149131.1	caldesmon isoform 5	CALD1
NP_005175.2	calmodulin	CALM3
NP_982284.1	calmodulin-regulated spectrin-associated protein 2	CAMSAP1L1
NP_001737.1	calnexin precursor	CANX
NP_001003962.1	calpain small subunit 1	CAPNS1
NP_005177.2	calpain-1 catalytic subunit	CAPN1
NP_001739.2	calpain-2 catalytic subunit isoform 1	CAPN2
NP_958434.1	calponin-2 isoform b	CNN2
NP_001830.1	calponin-3	CNN3
NP_004334.1	calreticulin precursor	CALR
NP_001210.1	calumenin isoform a precursor	CALU
NP_002725.1	cAMP-dependent protein kinase type I-alpha regulatory subunit	PRKAR1A
NP_006619.1	cAMP-regulated phosphoprotein 19	ARPP19
NP_000383.1	canalicular multispecific organic anion transporter 1	ABCC2
NP_115797.1	CAP-Gly domain-containing linker protein 2 isoform 2	CLIP2
NP_976240.1	caprin-1 isoform 2	CAPRIN1
NP_000058.1	carbonic anhydrase 2	CA2
NP_001748.1	carbonyl reductase [NADPH] 1	CBR1
NP_620164.1	carboxymethylenebutenolidase homolog	CMBL
NP_705838.3	cardiomyopathy-associated protein 5	CMYA5
NP_001883.4	casein kinase I isoform alpha isoform 2	CSNK1A1
NP_001887.1	casein kinase II subunit alpha'	CSNK2A2

Table 1 continued..

NP_808227.1	casein kinase II subunit alpha isoform a	CSNK2A1
NP_001311.3	casein kinase II subunit beta	CSNK2B
NP_116765.2	caspase-2 isoform 3	CASP2
NP_004337.2	caspase-3 preproprotein	CASP3
NP_001220.2	caspase-9 isoform alpha preproprotein	CASP9
NP_060299.4	cat eye syndrome chromosome region, candidate 5 isoform 1	CECR5
NP_001743.1	catalase	CAT
NP_009294.1	catechol O-methyltransferase isoform S-COMT	COMT
NP_001894.2	catenin alpha-1	CTNNA1
NP_037398.2	catenin alpha-3	CTNNA3
NP_001895.1	catenin beta-1	CTNNB1
NP_001193819.1	catenin delta-1 isoform 3A	CTNND1
NP_001323.1	catenin delta-2	CTNND2
NP_001899.1	cathepsin B preproprotein	CTSB
NP_001900.1	cathepsin D preproprotein	CTSD
NP_002346.1	cation-dependent mannose-6-phosphate receptor isoform 1 precursor	M6PR
NP_000867.2	cation-independent mannose-6-phosphate receptor precursor	IGF2R
NP_057368.3	CCR4-NOT transcription complex subunit 1 isoform a	CNOT1
NP_004348.2	CD151 antigen	CD151
NP_001230210.1	CD166 antigen isoform 3 precursor	ALCAM
NP_001189485.1	CD44 antigen isoform 7 precursor	CD44
NP_001120695.1	CD59 glycoprotein preproprotein	CD59
NP_001035123.1	CD63 antigen isoform B	CD63
NP_004347.1	CD81 antigen	CD81
NP_001760.1	CD9 antigen	CD9
NP_001775.2	CD97 antigen isoform 2 preproprotein	CD97
NP_001116370.1	CD99 antigen isoform b precursor	CD99
NP_001008389.1	CDGSH iron-sulfur domain-containing protein 2	CISD2
NP_788276.1	CDK5 regulatory subunit-associated protein 3	CDK5RAP3
NP_542387.1	CDKN2AIP N-terminal-like protein	CDKN2AIPNL
NP_660339.1	cell adhesion molecule 4 precursor	CADM4
NP_001782.1	cell division control protein 42 homolog isoform 1	CDC42
NP_060707.2	cell division cycle and apoptosis regulator protein 1	CCAR1
NP_001119588.1	cellular tumor antigen p53 isoform e	TP53
NP_004335.1	centrin-2	CETN2
NP_004715.1	centromere/kinetochore protein zw10 homolog	ZW10
NP_001804.2	centromere-associated protein E	CENPE
NP_055771.4	centrosomal protein of 164 kDa	CEP164
NP_001035863.1	centrosomal protein of 170 kDa isoform beta	CEP170
NP_009117.2	centrosome-associated protein CEP250	CEP250
NP_789782.1	charged multivesicular body protein 4b	CHMP4B
NP_689485.1	charged multivesicular body protein 7	CHMP7
NP_001136149.1	chitinase domain-containing protein 1 isoform c	CHID1
NP_001279.2	chloride intracellular channel protein 1	CLIC1
NP_039234.1	chloride intracellular channel protein 4	CLIC4
NP_001156737.1	choline-phosphate cytidylyltransferase B isoform 3	PCYT1B
NP_000046.1	cholinesterase precursor	BCHE
NP_001888.2	chondroitin sulfate proteoglycan 4 precursor	CSPG4
NP_056422.2	chromatin target of PRMT1 protein isoform 1	CHTOP
NP_057671.2	chromobox protein homolog 3	CBX3
NP_036249.1	chromobox protein homolog 5	CBX5
NP_001264.2	chromodomain-helicase-DNA-binding protein 4	CHD4
NP_060250.2	chromodomain-helicase-DNA-binding protein 7	CHD7
NP_004068.2	citrate synthase, mitochondrial precursor	CS
NP_001035529.1	C-Jun-amino-terminal kinase-interacting protein 3 isoform 2	MAPK8IP3

Table 1 continued..

NP_003962.3	C-Jun-amino-terminal kinase-interacting protein 4 isoform 3	SPAG9
NP_004850.1	clathrin heavy chain 1	CLTC
NP_001182485.1	clathrin interactor 1 isoform 3	CLINT1
NP_001824.1	clathrin light chain A isoform a	CLTA
NP_037423.2	cleavage and polyadenylation specificity factor subunit 1	CPSF1
NP_001075028.1	cleavage and polyadenylation specificity factor subunit 4 isoform 2	CPSF4
NP_008937.1	cleavage and polyadenylation specificity factor subunit 5	NUDT21
NP_008938.2	cleavage and polyadenylation specificity factor subunit 6	CPSF6
NP_001136037.1	cleavage and polyadenylation specificity factor subunit 7 isoform 3	CPSF7
NP_001028693.1	cleavage stimulation factor subunit 1	CSTF1
NP_001316.1	cleavage stimulation factor subunit 2	CSTF2
NP_001317.1	cleavage stimulation factor subunit 3 isoform 1	CSTF3
NP_001285.1	cleft lip and palate transmembrane protein 1	CLPTM1
NP_110409.2	cleft lip and palate transmembrane protein 1-like protein	CLPTM1L
NP_001135746.1	CLIP-associating protein 1 isoform 3	CLASP1
NP_001193973.1	CLIP-associating protein 2 isoform 2	CLASP2
NP_976084.1	clusterin precursor	CLU
NP_066972.1	coactosin-like protein	COTL1
NP_004362.2	coatamer subunit alpha isoform 2	COPA
NP_057535.1	coatamer subunit beta	COPB1
NP_004757.1	coatamer subunit beta'	COPB2
NP_001646.2	coatamer subunit delta isoform 1	ARCN1
NP_955474.1	coatamer subunit epsilon isoform b	COPE
NP_057212.1	coatamer subunit gamma	COPG
NP_036265.3	coatamer subunit gamma-2	COPG2
NP_057141.1	coatamer subunit zeta-1	COPZ1
NP_005498.1	cofilin-1	CFL1
NP_001230574.1	cofilin-2 isoform 2	CFL2
NP_001036216.1	cohesin subunit SA-2 isoform b	STAG2
NP_659457.2	coiled-coil domain-containing protein 11	CCDC11
NP_115733.2	coiled-coil domain-containing protein 115	CCDC115
NP_612451.1	coiled-coil domain-containing protein 124	CCDC124
NP_054727.1	coiled-coil domain-containing protein 22	CCDC22
NP_064583.2	coiled-coil domain-containing protein 47 precursor	CCDC47
NP_001271.1	cold-inducible RNA-binding protein	CIRBP
NP_001836.2	collagen alpha-1(IV) chain preproprotein	COL4A1
NP_112729.1	collagen type IV alpha-3-binding protein isoform 2	COL4A3BP
NP_057178.2	COMM domain-containing protein 2	COMMD2
NP_054905.2	COMM domain-containing protein 9 isoform 1	COMMD9
NP_001203.1	complement component 1 Q subcomponent-binding protein, mitochondrial precursor	C1QBP
NP_056536.2	component of gems 4	GEMIN4
NP_055680.3	condensin complex subunit 1	NCAPD2
NP_056156.2	condensin complex subunit 2	NCAPH
NP_071741.2	condensin complex subunit 3	NCAPG
NP_113619.2	conserved oligomeric Golgi complex subunit 3	COG3
NP_055427.2	constitutive coactivator of PPAR-gamma-like protein 1	FAM120A
NP_004118.3	COP9 signalosome complex subunit 1 isoform 2	GPS1
NP_004227.1	COP9 signalosome complex subunit 2 isoform 1	COPS2
NP_003644.2	COP9 signalosome complex subunit 3 isoform 1	COPS3
NP_057213.2	COP9 signalosome complex subunit 4	COPS4
NP_006828.2	COP9 signalosome complex subunit 5	COPS5
NP_006824.2	COP9 signalosome complex subunit 6	COPS6
NP_073567.1	COP9 signalosome complex subunit 7b	COPS7B
NP_006701.1	COP9 signalosome complex subunit 8 isoform 1	COPS8
NP_001185792.1	copine-1 isoform c	CPNE1

Table 1 continued..

NP_689940.3	copine-2	CPNE2
NP_003900.1	copine-3	CPNE3
NP_057044.2	copper homeostasis protein cutC homolog	CUTC
NP_004036.1	copper transport protein ATOX1	ATOX1
NP_613075.1	core histone macro-H2A.1 isoform 1	H2AFY
NP_009005.1	coronin-1A	CORO1A
NP_065174.1	coronin-1B	CORO1B
NP_055140.1	coronin-1C isoform 1	CORO1C
NP_001177385.1	coronin-2B isoform 2	CORO2B
NP_001188402.1	coronin-7 isoform 3	CORO7
NP_001814.2	creatine kinase B-type	CKB
NP_066270.1	creatine kinase U-type, mitochondrial precursor	CKMT1B
NP_005198.1	crk-like protein	CRKL
NP_001012632.1	C-terminal-binding protein 1 isoform 2	CTBP1
NP_001320.1	C-terminal-binding protein 2 isoform 1	CTBP2
NP_001896.2	CTP synthase 1	CTPS
NP_001137474.1	CTP synthase 2	CTPS2
NP_006030.2	C-type mannose receptor 2	MRC2
NP_006551.1	CUGBP Elav-like family member 1 isoform 1	CELF1
NP_001077060.1	CUGBP Elav-like family member 2 isoform 4	CELF2
NP_003582.2	cullin-2 isoform c	CUL2
NP_001008895.1	cullin-4A isoform 1	CUL4A
NP_003469.2	cullin-5	CUL5
NP_060918.2	cullin-associated NEDD8-dissociated protein 1	CAND1
NP_001777.1	cyclin-dependent kinase 1 isoform 1	CDK1
NP_439892.2	cyclin-dependent kinase 2 isoform 2	CDK2
NP_004633.1	cyclin-dependent kinase 2-associated protein 1	CDK2AP1
NP_001250.1	cyclin-dependent kinase 6	CDK6
NP_001817.1	cyclin-dependent kinases regulatory subunit 1	CKS1B
NP_005246.2	cyclin-G-associated kinase	GAK
NP_000062.1	cystathionine beta-synthase	CBS
NP_000091.1	cystatin-B	CSTB
NP_001180499.1	cysteine and glycine-rich protein 1 isoform 3	CSRP1
NP_001312.1	cysteine and glycine-rich protein 2	CSRP2
NP_001303.1	cysteine-rich protein 2	CRIP2
NP_644802.1	cysteinyl-tRNA synthetase, cytoplasmic isoform a	CARS
NP_085056.2	cytochrome b5 type B precursor	CYB5B
NP_005995.2	cytochrome b-c1 complex subunit 6, mitochondrial	UQCRH
NP_061820.1	cytochrome c	CYCS
NP_005685.1	cytochrome c oxidase copper chaperone	COX17
NP_001854.1	cytochrome c oxidase subunit 6B1	COX6B1
NP_057070.3	cytokine receptor-like factor 3	CRLF3
NP_002188.1	cytoplasmic aconitate hydratase	ACO1
NP_001367.2	cytoplasmic dynein 1 heavy chain 1	DYNC1H1
NP_001369.1	cytoplasmic dynein 1 intermediate chain 2	DYNC1H2
NP_057225.2	cytoplasmic dynein 1 light intermediate chain 1	DYNC1LI1
NP_006132.1	cytoplasmic dynein 1 light intermediate chain 2	DYNC1LI2
NP_055423.1	cytoplasmic FMR1-interacting protein 1 isoform a	CYFIP1
NP_006816.2	cytoskeleton-associated protein 4	CKAP4
NP_055571.2	cytoskeleton-associated protein 5 isoform b	CKAP5
NP_056991.2	cytosol aminopeptidase	LAP3
NP_863656.1	cytosolic acyl coenzyme A thioester hydrolase isoform hBACHd	ACOT7
NP_036357.1	cytosolic Fe-S cluster assembly factor NUBP2	NUBP2
NP_060705.2	cytosolic non-specific dipeptidase isoform 1	CNDP2
NP_036361.1	cytosolic purine 5'-nucleotidase	NT5C2

Table 1 continued..

NP_006614.2	D-3-phosphoglycerate dehydrogenase	PHGDH
NP_733829.1	DAZ-associated protein 1 isoform a	DAZAP1
NP_036228.1	DCC-interacting protein 13-alpha	APPL1
NP_065691.2	DCN1-like protein 1	DCUN1D1
NP_077001.1	dCTP pyrophosphatase 1	DCTPP1
NP_001346.1	D-dopachrome decarboxylase	DDT
NP_076424.1	DDRKG domain-containing protein 1 precursor	DDRKG1
NP_055504.2	dedicator of cytokinesis protein 10	DOCK10
NP_212132.2	dedicator of cytokinesis protein 7	DOCK7
NP_055577.1	delta(24)-sterol reductase precursor	DHCR24
NP_001389.2	delta(3,5)-Delta(2,4)-dienoyl-CoA isomerase, mitochondrial precursor	ECH1
NP_001017423.1	delta-1-pyrroline-5-carboxylate synthase isoform 2	ALDH18A1
NP_982353.1	delta-like protein 3 isoform 2 precursor	DLL3
NP_001193903.1	deoxyhypusine synthase isoform d	DHPS
NP_001366.1	deoxyribonuclease-2-alpha precursor	DNASE2
NP_954653.1	deoxyribonucleoside 5'-monophosphate N-glycosidase isoform 2	C6orf108
NP_001939.1	deoxyuridine 5'-triphosphate nucleotidohydrolase, mitochondrial isoform 2	DUT
NP_981958.1	dermal papilla-derived protein 6 isoform 2	C17orf81
NP_001918.3	desmin	DES
NP_001011546.1	destrin isoform b	DSTN
NP_620307.1	diablo homolog, mitochondrial isoform 3 precursor	DIABLO
NP_000099.2	dihydrolipoyl dehydrogenase, mitochondrial precursor	DLD
NP_001922.2	dihydrolipoyllysine-residue acetyltransferase component of pyruvate dehydrogenase complex, mitochondrial precursor	DLAT
NP_000311.2	dihydropteridine reductase	QDPR
NP_001304.1	dihydropyrimidinase-related protein 1 isoform 2	CRMP1
NP_001184222.1	dihydropyrimidinase-related protein 2 isoform 1	DPYSL2
NP_001184223.1	dihydropyrimidinase-related protein 3 isoform 1	DPYSL3
NP_006417.2	dihydropyrimidinase-related protein 4	DPYSL4
NP_064519.2	dihydropyrimidinase-related protein 5	DPYSL5
NP_005691.2	dipeptidyl peptidase 3	DPP3
NP_002452.1	diphosphomevalonate decarboxylase	MVD
NP_775873.2	disco-interacting protein 2 homolog B	DIP2B
NP_001914.3	DNA damage-binding protein 1	DDB1
NP_058633.2	DNA polymerase alpha catalytic subunit	POLA1
NP_002680.2	DNA polymerase alpha subunit B	POLA2
NP_006221.1	DNA polymerase delta subunit 2	POLD2
NP_001184260.1	DNA polymerase epsilon subunit 2 isoform 3	POLE2
NP_004517.2	DNA replication licensing factor MCM2	MCM2
NP_002379.2	DNA replication licensing factor MCM3	MCM3
NP_005905.2	DNA replication licensing factor MCM4	MCM4
NP_006730.2	DNA replication licensing factor MCM5	MCM5
NP_005906.2	DNA replication licensing factor MCM6	MCM6
NP_005907.3	DNA replication licensing factor MCM7 isoform 1	MCM7
NP_001632.2	DNA-(apurinic or apyrimidinic site) lyase	APEX1
NP_001015054.1	DNA-3-methyladenine glycosylase isoform c	MPG
NP_001138898.1	DNA-binding protein A isoform b	CSDA
NP_056080.1	DNA-binding protein SATB2	SATB2
NP_008835.5	DNA-dependent protein kinase catalytic subunit isoform 1	PRKDC
NP_000928.1	DNA-directed RNA polymerase II subunit RPB1	POLR2A
NP_000929.1	DNA-directed RNA polymerase II subunit RPB2	POLR2B
NP_006223.2	DNA-directed RNA polymerases I, II, and III subunit RPABC3	POLR2H
NP_001530.1	dnaJ homolog subfamily A member 1	DNAJA1
NP_005871.1	dnaJ homolog subfamily A member 2	DNAJA2
NP_006136.1	dnaJ homolog subfamily B member 1	DNAJB1

Table 1 continued..

NP_057390.1	dnaJ homolog subfamily B member 11 precursor	DNAJB11
NP_061854.1	dnaJ homolog subfamily C member 10 precursor	DNAJC10
NP_056083.3	dnaJ homolog subfamily C member 13	DNAJC13
NP_060633.1	dnaJ homolog subfamily C member 17	DNAJC17
NP_006251.1	dnaJ homolog subfamily C member 3 precursor	DNAJC3
NP_056005.1	dnaJ homolog subfamily C member 9	DNAJC9
NP_003850.1	dolichol-phosphate mannosyltransferase	DPM1
NP_714963.1	dolichyl-phosphate mannosyltransferase subunit 3 isoform 2	DPM3
NP_005207.2	dolichyl-diphosphooligosaccharide--protein glycosyltransferase 48 kDa subunit precursor	DDOST
NP_002941.1	dolichyl-diphosphooligosaccharide--protein glycosyltransferase subunit 1 precursor	RPN1
NP_001129243.1	dolichyl-diphosphooligosaccharide--protein glycosyltransferase subunit 2 isoform 2 precursor	RPN2
NP_001335.1	dolichyl-diphosphooligosaccharide--protein glycosyltransferase subunit DAD1	DAD1
NP_689926.1	dolichyl-diphosphooligosaccharide--protein glycosyltransferase subunit STT3A	STT3A
NP_849193.1	dolichyl-diphosphooligosaccharide--protein glycosyltransferase subunit STT3B	STT3B
NP_005581.2	double-strand break repair protein MRE11A isoform 2	MRE11A
NP_001157855.1	double-stranded RNA-binding protein Staufen homolog 2 isoform d	STAU2
NP_001020278.1	double-stranded RNA-specific adenosine deaminase isoform d	ADAR
NP_004386.2	drebrin isoform a	DBN1
NP_054782.2	drebrin-like protein isoform a	DBNL
NP_001014436.1	drebrin-like protein isoform b	DBNL
NP_543010.3	D-tyrosyl-tRNA(Tyr) deacylase 1	DTD1
NP_002746.1	dual specificity mitogen-activated protein kinase kinase 1	MAP2K1
NP_109587.1	dual specificity mitogen-activated protein kinase kinase 2	MAP2K2
NP_004081.1	dual specificity protein phosphatase 3	DUSP3
NP_001128513.1	dynactin subunit 1 isoform 4	DCTN1
NP_006391.1	dynactin subunit 2	DCTN2
NP_001129116.1	dynactin subunit 4 isoform c	DCTN4
NP_036193.2	dynamamin-1-like protein isoform 2	DNM1L
NP_004936.2	dynamamin-2 isoform 3	DNM2
NP_056036.1	dynamamin-binding protein	DNMBP
NP_570844.1	dynamamin-like 120 kDa protein, mitochondrial isoform 2	OPA1
NP_997320.2	dynein heavy chain 10, axonemal	DNAH10
NP_065928.2	dynein heavy chain 2, axonemal	DNAH2
NP_653267.2	dynein heavy chain domain-containing protein 1 isoform 1	DNHD1
NP_001032583.1	dynein light chain 1, cytoplasmic	DYNLL1
NP_054902.1	dynein light chain roadblock-type 1	DYNLRB1
NP_006510.1	dynein light chain Tctex-type 1	DYNLT1
NP_006258.3	E3 SUMO-protein ligase RanBP2	RANBP2
NP_005073.2	E3 ubiquitin/ISG15 ligase TRIM25	TRIM25
NP_062538.5	E3 ubiquitin-protein ligase BRE1A	RNF20
NP_005852.2	E3 ubiquitin-protein ligase CHIP	STUB1
NP_113584.3	E3 ubiquitin-protein ligase HUWE1	HUWE1
NP_064507.3	E3 ubiquitin-protein ligase KCMF1	KCMF1
NP_071347.2	E3 ubiquitin-protein ligase RNF123	RNF123
NP_443210.1	E3 ubiquitin-protein ligase TRIM9 isoform 2	TRIM9
NP_065816.2	E3 ubiquitin-protein ligase UBR4	UBR4
NP_001041666.1	E3 ubiquitin-protein ligase UHRF1 isoform 1	UHRF1
NP_056138.1	E3 UFM1-protein ligase 1	KIAA0776
NP_003557.2	early endosome antigen 1	EEA1
NP_077305.2	EF-hand domain-containing protein D2	EFHD2
NP_006786.2	EH domain-containing protein 1	EHD1
NP_055415.1	EH domain-containing protein 3	EHD3
NP_001410.2	ELAV-like protein 1	ELAVL1
NP_001121188.1	electron transfer flavoprotein subunit alpha, mitochondrial isoform b	ETFA
NP_001976.1	electron transfer flavoprotein subunit beta isoform 1	ETFB

Table 1 continued..

NP_829883.1	ELKS/Rab6-interacting/CAST family member 1 isoform delta	ERC1
NP_001393.1	elongation factor 1-alpha 1	EEF1A1
NP_001949.1	elongation factor 1-alpha 2	EEF1A2
NP_001950.1	elongation factor 1-beta	EEF1B2
NP_001951.2	elongation factor 1-delta isoform 2	EEF1D
NP_001395.1	elongation factor 1-gamma	EEF1G
NP_001952.1	elongation factor 2	EEF2
NP_003312.3	elongation factor Tu, mitochondrial precursor	TUFM
NP_073732.1	elongation of very long chain fatty acids protein 1	ELOVL1
NP_003631.2	elongator complex protein 1	IKBKAP
NP_000108.1	emerin	EMD
NP_003016.1	endophilin-A2 isoform 1	SH3GL1
NP_001193582.1	endophilin-B1 isoform 4	SH3GLB1
NP_001185470.1	endoplasmic reticulum aminopeptidase 1 isoform b precursor	ERAP1
NP_006808.1	endoplasmic reticulum resident protein 29 isoform 1 precursor	ERP29
NP_055866.1	endoplasmic reticulum resident protein 44 precursor	ERP44
NP_003290.1	endoplasmic precursor	HSP90B1
NP_055144.3	enhancer of mRNA-decapping protein 4	EDC4
NP_004441.1	enhancer of rudimentary homolog	ERH
NP_067027.1	enolase-phosphatase E1	ENOPH1
NP_001159482.1	enoyl-CoA delta isomerase 2, mitochondrial isoform 1	ECI2
NP_004083.3	enoyl-CoA hydratase, mitochondrial precursor	ECHS1
NP_005224.2	ephrin type-A receptor 3 isoform a precursor	EPHA3
NP_004434.2	ephrin type-B receptor 3 precursor	EPHB3
NP_005219.2	epidermal growth factor receptor isoform a precursor	EGFR
NP_004438.3	epidermal growth factor receptor kinase substrate 8	EPS8
NP_006423.1	epididymal secretory protein E1 precursor	NPC2
NP_112598.2	epiplakin	EPPK1
NP_001945.3	epithelial discoidin domain-containing receptor 1 isoform 1 precursor	DDR1
NP_001129490.1	epoxide hydrolase 1	EPHX1
NP_037465.2	epsin-1 isoform c	EPN1
NP_001094073.1	ER lumen protein retaining receptor 2 isoform 2	KDELR2
NP_009106.1	erlin-2 isoform 1	ERLIN2
NP_055399.1	ERO1-like protein alpha precursor	ERO1L
NP_054758.2	ester hydrolase C11orf54	C11orf54
NP_057226.1	estradiol 17-beta-dehydrogenase 12	HSD17B12
NP_002852.1	ethanolamine-phosphate cytidylyltransferase isoform 2	PCYT2
NP_001407.1	eukaryotic initiation factor 4A-I isoform 1	EIF4A1
NP_001958.2	eukaryotic initiation factor 4A-II	EIF4A2
NP_055555.1	eukaryotic initiation factor 4A-III	EIF4A3
NP_001123478.1	eukaryotic peptide chain release factor GTP-binding subunit ERF3A isoform 2	GSPT1
NP_060564.2	eukaryotic peptide chain release factor GTP-binding subunit ERF3B	GSPT2
NP_004721.1	eukaryotic peptide chain release factor subunit 1	ETF1
NP_005866.1	eukaryotic translation initiation factor 1b	EIF1B
NP_004085.1	eukaryotic translation initiation factor 2 subunit 1	EIF2S1
NP_001406.1	eukaryotic translation initiation factor 2 subunit 3	EIF2S3
NP_003741.1	eukaryotic translation initiation factor 3 subunit A	EIF3A
NP_003742.2	eukaryotic translation initiation factor 3 subunit B	EIF3B
NP_003743.1	eukaryotic translation initiation factor 3 subunit C	EIF3C
NP_003744.1	eukaryotic translation initiation factor 3 subunit D	EIF3D
NP_001559.1	eukaryotic translation initiation factor 3 subunit E	EIF3E
NP_003745.1	eukaryotic translation initiation factor 3 subunit F	EIF3F
NP_003746.2	eukaryotic translation initiation factor 3 subunit G	EIF3G
NP_003747.1	eukaryotic translation initiation factor 3 subunit H	EIF3H
NP_003748.1	eukaryotic translation initiation factor 3 subunit I	EIF3I

Table 1 continued..

NP_003749.2	eukaryotic translation initiation factor 3 subunit J	EIF3J
NP_037366.1	eukaryotic translation initiation factor 3 subunit K	EIF3K
NP_001229852.1	eukaryotic translation initiation factor 3 subunit L isoform 2	EIF3L
NP_006351.2	eukaryotic translation initiation factor 3 subunit M	EIF3M
NP_004944.3	eukaryotic translation initiation factor 4 gamma 1 isoform 4	EIF4G1
NP_001036024.3	eukaryotic translation initiation factor 4 gamma 2 isoform 2	EIF4G2
NP_003751.2	eukaryotic translation initiation factor 4 gamma 3 isoform 3	EIF4G3
NP_001408.2	eukaryotic translation initiation factor 4E	EIF4B
NP_001959.1	eukaryotic translation initiation factor 4E isoform 1	EIF4E
NP_004086.1	eukaryotic translation initiation factor 4E-binding protein 1	EIF4EBP1
NP_004087.1	eukaryotic translation initiation factor 4E-binding protein 2	EIF4EBP2
NP_114381.1	eukaryotic translation initiation factor 4H isoform 2	EIF4H
NP_001960.2	eukaryotic translation initiation factor 5	EIF5
NP_001961.1	eukaryotic translation initiation factor 5A-1 isoform B	EIF5A
NP_056988.3	eukaryotic translation initiation factor 5B	EIF5B
NP_002203.1	eukaryotic translation initiation factor 6 isoform a	EIF6
NP_001160167.1	excitatory amino acid transporter 1 isoform 2	SLC1A3
NP_839955.1	exocyst complex component 1 isoform 2	EXOC1
NP_060773.3	exocyst complex component 2	EXOC2
NP_009208.2	exocyst complex component 3	EXOC3
NP_068579.3	exocyst complex component 4 isoform a	EXOC4
NP_056034.2	exocyst complex component 7 isoform 2	EXOC7
NP_787072.2	exocyst complex component 8	EXOC8
NP_057130.1	exosome complex component CSL4	EXOSC1
NP_064543.3	exosome complex component RRP46	EXOSC5
NP_003391.1	exportin-1	XPO1
NP_001307.2	exportin-2	CSE1L
NP_071904.4	exportin-4	XPO4
NP_065801.1	exportin-5	XPO5
NP_055839.3	exportin-7	XPO7
NP_009166.2	exportin-T	XPOT
NP_056107.1	extended synaptotagmin-1 isoform 2	ESYT1
NP_001981.2	eyes absent homolog 3	EYA3
NP_003370.2	ezrin	EZR
NP_009123.1	FACT complex subunit SPT16	SUPT16H
NP_003137.1	FACT complex subunit SSRP1	SSRP1
NP_006126.1	F-actin-capping protein subunit alpha-1	CAPZA1
NP_006127.1	F-actin-capping protein subunit alpha-2	CAPZA2
NP_004921.1	F-actin-capping protein subunit beta isoform 1	CAPZB
NP_110424.1	family with sequence similarity 49, member A	FAM49A
NP_001035894.1	family with sequence similarity 98, member B isoform 2	FAM98B
NP_003893.2	far upstream element-binding protein 1	FUBP1
NP_003676.2	far upstream element-binding protein 2	KHSRP
NP_003925.1	far upstream element-binding protein 3	FUBP3
NP_001129294.1	farnesyl pyrophosphate synthase isoform b	FDPS
NP_003079.1	fascin	FSCN1
NP_004095.4	fatty acid synthase	FASN
NP_001437.1	fatty acid-binding protein, brain	FABP7
NP_004093.1	fatty acid-binding protein, heart	FABP3
NP_000373.1	fatty aldehyde dehydrogenase isoform 2	ALDH3A2
NP_387449.2	F-box/WD repeat-containing protein 11 isoform A	FBXW11
NP_078941.2	F-box-like/WD repeat-containing protein TBL1XR1	TBL1XR1
NP_005757.1	FERM, RhoGEF and pleckstrin domain-containing protein 1 isoform 1	FARP1
NP_001128472.1	fermitin family homolog 2 isoform 3	FERMT2
NP_002023.2	ferritin heavy chain	FTH1

Table 1 continued..

NP_000137.2	ferritin light chain	FTL
NP_997639.1	fibronectin isoform 6 preproprotein	FN1
NP_775922.2	fibrous sheath-interacting protein 2	FSIP2
NP_001447.2	filamin-A isoform 1	FLNA
NP_001157791.1	filamin-B isoform 4	FLNB
NP_004102.1	flap endonuclease 1	FEN1
NP_000704.1	flavin reductase	BLVRB
NP_005794.1	flotillin-1	FLOT1
NP_004466.2	flotillin-2	FLOT2
NP_001032242.1	forkhead box protein K1	FOXK1
NP_944489.2	formin-like protein 3 isoform 2	FMNL3
NP_001153175.1	four and a half LIM domains protein 1 isoform 4	FHL1
NP_001013457.1	fragile X mental retardation syndrome-related protein 1 isoform c	FXR1
NP_997244.3	FRAS1-related extracellular matrix protein 2 precursor	FREM2
NP_000025.1	fructose-bisphosphate aldolase A isoform 1	ALDOA
NP_005156.1	fructose-bisphosphate aldolase C	ALDOC
NP_000134.2	fumarate hydratase, mitochondrial precursor	FH
NP_000145.1	galactokinase	GALK1
NP_002296.1	galectin-1	LGALS1
NP_002297.2	galectin-3 isoform 1	LGALS3
NP_005558.1	galectin-3-binding protein	LGALS3BP
NP_001966.1	gamma-enolase	ENO2
NP_003869.1	gamma-glutamyl hydrolase precursor	GGH
NP_076956.1	gamma-glutamylcyclotransferase isoform 1	GGCT
NP_005522.2	gamma-interferon-inducible protein 16 isoform 2	IFI16
NP_006650.1	gamma-tubulin complex component 2	TUBGCP2
NP_000396.2	ganglioside GM2 activator isoform 1 precursor	GM2A
NP_758436.1	GDP-fucose protein O-fucosyltransferase 1 isoform 2 precursor	POFUT1
NP_056042.1	GDP-fucose protein O-fucosyltransferase 2 isoform A	POFUT2
NP_001121134.1	gelsolin isoform b	GSN
NP_001511.2	general transcription factor 3C polypeptide 1	GTF3C1
NP_036336.2	general transcription factor 3C polypeptide 4	GTF3C4
NP_002087.2	general transcription factor IIF subunit 1	GTF2F1
NP_001508.1	general transcription factor IIIH subunit 4	GTF2H4
NP_001509.3	general transcription factor II-I isoform 4	GTF2I
NP_003706.1	general vesicular transport factor p115	USO1
NP_001032354.1	geranylgeranyl pyrophosphate synthase	GGPS1
NP_004115.1	glia maturation factor beta	GMFB
NP_036516.1	glucocorticoid modulatory element-binding protein 2	GMEB2
NP_612435.1	glucocorticoid-induced transcript 1 protein	GLCCI1
NP_005462.1	glucosamine-6-phosphate isomerase 1	GNPDA1
NP_002047.2	glucosamine--fructose-6-phosphate aminotransferase [isomerizing] 1	GFPT1
NP_001035810.1	glucose-6-phosphate 1-dehydrogenase isoform b	G6PD
NP_000166.2	glucose-6-phosphate isomerase isoform 2	GPI
NP_001001329.1	glucosidase 2 subunit beta isoform 2	PRKCSH
NP_001165282.1	glucosylceramidase isoform 2	GBA
NP_005262.1	glutamate dehydrogenase 1, mitochondrial precursor	GLUD1
NP_113673.3	glutamate-rich WD repeat-containing protein 1	GRWD1
NP_055720.3	glutaminase kidney isoform, mitochondrial precursor	GLS
NP_002056.2	glutamine synthetase	GLUL
NP_005042.1	glutaminyl-tRNA synthetase	QARS
NP_001230587.1	glutaredoxin-1	GLRX
NP_006532.2	glutaredoxin-3	GLRX3
NP_000572.2	glutathione peroxidase 1 isoform 1	GPX1
NP_056511.2	glutathione peroxidase 7 precursor	GPX7

Table 1 continued..

NP_001182031.1	glutathione reductase, mitochondrial isoform 2 precursor	GSR
NP_001503.1	glutathione S-transferase A4	GSTA4
NP_001137153.1	glutathione S-transferase kappa 1 isoform d	GSTK1
NP_001135840.1	glutathione S-transferase Mu 2 isoform 2	GSTM2
NP_000840.2	glutathione S-transferase Mu 3	GSTM3
NP_001177932.1	glutathione S-transferase omega-1 isoform 3	GSTO1
NP_000843.1	glutathione S-transferase P	GSTP1
NP_000169.1	glutathione synthetase	GSS
NP_002037.2	glyceraldehyde-3-phosphate dehydrogenase	GAPDH
NP_004474.2	glycine cleavage system H protein, mitochondrial precursor	GCSH
NP_001155059.1	glycogen [starch] synthase, muscle isoform 2	GYS1
NP_002853.2	glycogen phosphorylase, brain form	PYGB
NP_001157412.1	glycogen phosphorylase, liver form isoform 2	PYGL
NP_001139628.1	glycogen synthase kinase-3 beta isoform 2	GSK3B
NP_001171649.1	glycogenin-1 isoform 2	GYG1
NP_057517.1	glycolipid transfer protein	GLTP
NP_066565.1	glycylpeptide N-tetradecanoyltransferase 1	NMT1
NP_002038.2	glycyl-tRNA synthetase	GARS
NP_057164.3	glyoxalase domain-containing protein 4	GLOD4
NP_036335.1	glyoxylate reductase/hydroxypyruvate reductase	GRHPR
NP_002072.2	glypican-1 precursor	GPC1
NP_005699.1	glypican-6 precursor	GPC6
NP_003866.1	GMP synthase [glutamine-hydrolyzing]	GMPS
NP_001139139.1	Golgi apparatus protein 1 isoform 3	GLG1
NP_055313.1	Golgi integral membrane protein 4	GOLIM4
NP_057632.2	Golgi membrane protein 1	GOLM1
NP_060648.2	Golgi phosphoprotein 3-like	GOLPH3L
NP_073572.2	Golgi resident protein GCP60	ACBD3
NP_071738.1	Golgi-associated plant pathogenesis-related protein 1	GLIPR2
NP_001186308.1	Golgi-specific brefeldin A-resistance guanine nucleotide exchange factor 1 isoform 3	GBF1
NP_079265.2	GPI inositol-deacylase	PGAP1
NP_958932.1	G-protein coupled receptor 56 isoform b precursor	GPR56
NP_002078.1	granulins precursor	GRN
NP_002083.3	G-rich sequence factor 1 isoform 1	GRSF1
NP_987102.1	growth factor receptor-bound protein 2 isoform 2	GRB2
NP_789765.1	GTPase HRas isoform 2	HRAS
NP_056450.2	GTPase-activating protein and VPS9 domain-containing protein 1	GAPVD1
NP_006316.1	GTP-binding nuclear protein Ran	RAN
NP_005605.1	GTP-binding protein Rheb precursor	RHEB
NP_001028675.1	GTP-binding protein SAR1b	SAR1B
NP_000147.1	guanidinoacetate N-methyltransferase isoform a	GAMT
NP_002061.1	guanine nucleotide-binding protein G(i) subunit alpha-2 isoform 1	GNAI2
NP_061329.3	guanine nucleotide-binding protein G(I)/G(S)/G(O) subunit gamma-12 precursor	GNG12
NP_005265.1	guanine nucleotide-binding protein G(I)/G(S)/G(O) subunit gamma-5 precursor	GNG5
NP_002065.1	guanine nucleotide-binding protein G(I)/G(S)/G(T) subunit beta-1	GNB1
NP_005264.2	guanine nucleotide-binding protein G(I)/G(S)/G(T) subunit beta-2	GNB2
NP_006487.1	guanine nucleotide-binding protein G(k) subunit alpha	GNAI3
NP_006563.2	guanine nucleotide-binding protein subunit alpha-13	GNA13
NP_004288.1	guanine nucleotide-binding protein subunit alpha-14	GNA14
NP_006089.1	guanine nucleotide-binding protein subunit beta-2-like 1	GNB2L1
NP_005266.2	guanine nucleotide-binding protein-like 1	GNL1
NP_061856.1	H/ACA ribonucleoprotein complex subunit 1	GAR1
NP_001135935.1	H/ACA ribonucleoprotein complex subunit 4 isoform 2	DKC1
NP_001018238.1	HCLS1-associated protein X-1 isoform b	HAX1
NP_071905.3	HCLS1-binding protein 3	HS1BP3

Table 1 continued..

NP_057147.2	HD domain-containing protein 2	HDDC2
NP_060272.3	HEAT repeat-containing protein 2	HEATR2
NP_005337.2	heat shock 70 kDa protein 1A/1B	HSPA1B
NP_002145.3	heat shock 70 kDa protein 4	HSPA4
NP_006588.1	heat shock cognate 71 kDa protein isoform 1	HSPA8
NP_001528.1	heat shock factor-binding protein 1	HSBP1
NP_006635.2	heat shock protein 105 kDa	HSPH1
NP_057376.2	heat shock protein 75 kDa, mitochondrial precursor	TRAP1
NP_001531.1	heat shock protein beta-1	HSPB1
NP_005339.3	heat shock protein HSP 90-alpha isoform 2	HSP90AA1
NP_031381.2	heat shock protein HSP 90-beta	HSP90AB1
NP_057269.1	hematological and neurological expressed 1 protein isoform 1	HN1
NP_653171.1	hematological and neurological expressed 1-like protein	HN1L
NP_055135.1	heme-binding protein 2	HEBP2
NP_006393.2	hepatitis B virus X-interacting protein	HBXIP
NP_004703.1	hepatocyte growth factor-regulated tyrosine kinase substrate	HGS
NP_004485.1	hepatoma-derived growth factor isoform a	HDGF
NP_116020.1	hepatoma-derived growth factor-related protein 2 isoform 2	HDGFRP2
NP_004490.2	heterogeneous nuclear ribonucleoprotein A/B isoform b	HNRNPAB
NP_006796.1	heterogeneous nuclear ribonucleoprotein A0	HNRNPA0
NP_002127.1	heterogeneous nuclear ribonucleoprotein A1 isoform a	HNRNPA1
NP_919223.1	heterogeneous nuclear ribonucleoprotein A3	HNRNPA3
NP_001003810.1	heterogeneous nuclear ribonucleoprotein D0 isoform d	HNRNPD
NP_001193929.1	heterogeneous nuclear ribonucleoprotein D-like isoform b	HNRPDL
NP_004957.1	heterogeneous nuclear ribonucleoprotein F	HNRNPF
NP_062556.2	heterogeneous nuclear ribonucleoprotein G-like 1	RBMXL1
NP_005511.1	heterogeneous nuclear ribonucleoprotein H	HNRNPH1
NP_062543.1	heterogeneous nuclear ribonucleoprotein H2	HNRNPH2
NP_067676.2	heterogeneous nuclear ribonucleoprotein H3 isoform b	HNRNPH3
NP_112552.1	heterogeneous nuclear ribonucleoprotein K isoform b	HNRNPK
NP_001524.2	heterogeneous nuclear ribonucleoprotein L isoform a	HNRNPL
NP_005959.2	heterogeneous nuclear ribonucleoprotein M isoform a	HNRNPM
NP_006363.4	heterogeneous nuclear ribonucleoprotein Q isoform 1	SYNCRIP
NP_005817.1	heterogeneous nuclear ribonucleoprotein R isoform 2	HNRNPR
NP_114032.2	heterogeneous nuclear ribonucleoprotein U isoform a	HNRNPU
NP_653333.1	heterogeneous nuclear ribonucleoprotein U-like protein 1 isoform d	HNRNPUL1
NP_001073027.1	heterogeneous nuclear ribonucleoprotein U-like protein 2	HNRNPUL2
NP_112533.1	heterogeneous nuclear ribonucleoproteins A2/B1 isoform B1	HNRNPA2B1
NP_004491.2	heterogeneous nuclear ribonucleoproteins C1/C2 isoform b	HNRNPC
NP_000179.2	hexokinase-1 isoform HK1	HK1
NP_002119.1	high mobility group protein B1	HMGB1
NP_001124160.1	high mobility group protein B2	HMGB2
NP_005333.2	high mobility group protein B3	HMGB3
NP_665906.1	high mobility group protein HMG-I/HMG-Y isoform a	HMGA1
NP_002140.2	hippocalcin-like protein 1	HPCAL1
NP_005331.1	histidine triad nucleotide-binding protein 1	HINT1
NP_115982.1	histidine triad nucleotide-binding protein 2, mitochondrial precursor	HINT2
NP_002100.2	histidyl-tRNA synthetase, cytoplasmic	HARS
NP_003633.1	histone acetyltransferase type B catalytic subunit	HAT1
NP_004955.2	histone deacetylase 1	HDAC1
NP_001518.3	histone deacetylase 2	HDAC2
NP_006028.2	histone deacetylase 4	HDAC4
NP_006035.2	histone deacetylase 6	HDAC6
NP_005310.1	histone H1.2	HIST1H1C
NP_005312.1	histone H1.4	HIST1H1E

Table 1 continued..

NP_005313.1	histone H1.5	HIST1H1B
NP_006017.1	histone H1x	H1FX
NP_003508.1	histone H2A type 2-C	HIST2H2AC
NP_002096.1	histone H2A.x	H2AFX
NP_002097.1	histone H2A.Z	H2AFZ
NP_066406.1	histone H2B type 1-B	HIST1H2BB
NP_066407.1	histone H2B type 1-D	HIST1H2BD
NP_003520.1	histone H3.1	HIST1H3A
NP_001116847.1	histone H3.2	HIST2H3D
NP_005315.1	histone H3.3	H3F3B
NP_003529.1	histone H4	HIST1H4A
NP_005601.1	histone-binding protein RBBP4 isoform a	RBBP4
NP_002884.1	histone-binding protein RBBP7 isoform 2	RBBP7
NP_055542.1	histone-lysine N-methyltransferase MLL4	MLL4
NP_002107.3	HLA class I histocompatibility antigen, A-1 alpha chain precursor	HLA-A
NP_001229971.1	HLA class I histocompatibility antigen, Cw-1 alpha chain precursor	HLA-C
NP_057123.1	homeobox prox 1	C14orf166
NP_005325.2	host cell factor 1	HCFC1
NP_003923.2	hsc70-interacting protein	ST13
NP_008996.1	hsp90 co-chaperone Cdc37	CDC37
NP_002102.4	huntingtin	HTT
NP_001230127.1	huntingtin-interacting protein 1 isoform 2	HIP1
NP_057484.3	huntingtin-interacting protein K isoform 1	C15orf63
NP_001875.1	hyaluronan and proteoglycan link protein 1 precursor	HAPLN1
NP_005318.3	hydroxyacyl-coenzyme A dehydrogenase, mitochondrial isoform 2 precursor	HADH
NP_001035517.1	hydroxyacylglutathione hydrolase, mitochondrial isoform 2	HAGH
NP_001091742.1	hydroxymethylglutaryl-CoA synthase, cytoplasmic	HMGCS1
NP_001182751.1	hydroxysteroid dehydrogenase-like protein 2 isoform 2	HSDL2
NP_055862.1	hypothetical protein LOC23065 precursor	KIAA0090
NP_001025034.1	hypothetical protein LOC387263 precursor	C6orf120
NP_057584.2	hypothetical protein LOC51260	CXorf26
NP_057707.3	hypothetical protein LOC51571	FAM49B
NP_064710.4	hypothetical protein LOC57020	C16orf62
NP_067066.1	hypothetical protein LOC58527	C6orf115
NP_068744.1	hypothetical protein LOC60526	C2orf43
NP_075568.1	hypothetical protein LOC65265	C8orf33
NP_076943.1	hypothetical protein LOC79002	C19orf43
NP_001093878.1	hypothetical protein LOC79415 isoform b	C17orf62
NP_001177396.1	hypothetical protein LOC80164	FLJ22184
NP_115726.1	hypothetical protein LOC84310	C7orf50
NP_055495.2	hypothetical protein LOC9703 precursor	KIAA0100
NP_000185.1	hypoxanthine-guanine phosphoribosyltransferase	HPRT1
NP_006380.1	hypoxia up-regulated protein 1 precursor	HYOU1
NP_001007562.1	immunity-related GTPase family Q protein	IRGQ
NP_002255.3	importin subunit alpha-1	KPNA1
NP_002257.1	importin subunit alpha-2	KPNA2
NP_002258.2	importin subunit alpha-3	KPNA3
NP_002259.1	importin subunit alpha-4	KPNA4
NP_036448.1	importin subunit alpha-7	KPNA6
NP_002256.2	importin subunit beta-1	KPNB1
NP_057422.3	importin-11 isoform 2	IPO11
NP_055467.3	importin-13	IPO13
NP_078934.3	importin-4	IPO4
NP_002262.3	importin-5	IPO5
NP_006382.1	importin-7	IPO7

Table 1 continued..

NP_001177924.1	importin-8 isoform 2	IPO8
NP_060555.2	importin-9	IPO9
NP_001229707.1	inhibitor of nuclear factor kappa-B kinase subunit beta isoform 5	IKBKB
NP_710154.1	inhibitor of nuclear factor kappa-B kinase-interacting protein isoform 1	IKBIP
NP_066952.1	inorganic pyrophosphatase	PPA1
NP_789842.2	inorganic pyrophosphatase 2, mitochondrial isoform 3 precursor	PPA2
NP_258412.1	inosine triphosphate pyrophosphatase isoform a	ITPA
NP_000875.2	inosine-5'-monophosphate dehydrogenase 2	IMPDH2
NP_005527.1	inositol monophosphatase 1 isoform 1	IMPA1
NP_055029.1	inositol monophosphatase 2	IMPA2
NP_001164410.1	inositol-3-phosphate synthase 1 isoform 3	ISYNA1
NP_001007226.1	insulin-like growth factor 2 mRNA-binding protein 2 isoform b	IGF2BP2
NP_006538.2	insulin-like growth factor 2 mRNA-binding protein 3	IGF2BP3
NP_001012532.1	integral membrane protein 2C isoform 3	ITM2C
NP_075391.3	integrator complex subunit 3	INTS3
NP_001035026.1	integrator complex subunit 6 isoform b	INTS6
NP_001138471.1	integrin alpha-V isoform 2	ITGAV
NP_596867.1	integrin beta-1 isoform 1A precursor	ITGB1
NP_110395.1	integrin-linked kinase-associated serine/threonine phosphatase 2C	ILKAP
NP_004508.1	integrin-linked protein kinase	ILK
NP_001184054.1	interferon regulatory factor 3 isoform 5	IRF3
NP_001129124.1	interferon-induced, double-stranded RNA-activated protein kinase isoform b	EIF2AK2
NP_001132990.1	interferon-inducible double stranded RNA-dependent protein kinase activator A isoform 3	PRKRA
NP_004506.2	interleukin enhancer-binding factor 2	ILF2
NP_036350.2	interleukin enhancer-binding factor 3 isoform a	ILF3
NP_055097.2	intracellular hyaluronan-binding protein 4	HABP4
NP_055506.1	intron-binding protein aquarius	AQR
NP_001026884.3	inverted formin-2 isoform 2	INF2
NP_001104595.1	IQ motif and SEC7 domain-containing protein 2 isoform 1	IQSEC2
NP_001034702.1	isoamyl acetate-hydrolyzing esterase 1 homolog	IAH1
NP_001129673.1	isochorismatase domain-containing protein 2, mitochondrial isoform 1	ISOC2
NP_005521.1	isocitrate dehydrogenase [NAD] subunit alpha, mitochondrial precursor	IDH3A
NP_005887.2	isocitrate dehydrogenase [NADP] cytoplasmic	IDH1
NP_002159.2	isocitrate dehydrogenase [NADP], mitochondrial precursor	IDH2
NP_002152.2	isoleucyl-tRNA synthetase, cytoplasmic	IARS
NP_060530.3	isoleucyl-tRNA synthetase, mitochondrial precursor	IARS2
NP_004499.2	isopentenyl-diphosphate Delta-isomerase 1	IDI1
NP_000412.3	keratin, type I cytoskeletal 10	KRT10
NP_000217.2	keratin, type I cytoskeletal 9	KRT9
NP_006112.3	keratin, type II cytoskeletal 1	KRT1
NP_006550.1	KH domain-containing, RNA-binding, signal transduction-associated protein 1	KHDRBS1
NP_056449.1	KIF1-binding protein	KIAA1279
NP_004977.2	kinectin isoform c	KTN1
NP_005543.2	kinesin light chain 1 isoform 1	KLC1
NP_004512.1	kinesin-1 heavy chain	KIF5B
NP_056069.2	kinesin-like protein KIF13B	KIF13B
NP_064627.1	kinesin-like protein KIF15	KIF15
NP_004312.2	kinesin-like protein KIF1A isoform 2	KIF1A
NP_001166936.1	kinesin-like protein KIF21A isoform 4	KIF21A
NP_001230881.1	kinesin-like protein KIF2A isoform 3	KIF2A
NP_872319.1	kinetochore protein Spc24	SPC24
NP_001108086.1	lactadherin isoform b	MFGE8
NP_006699.2	lactoylglutathione lyase	GLO1
NP_078828.2	LAG1 longevity assurance homolog 4	CERS4
NP_919424.1	lamin-B receptor	LBR

Table 1 continued..

NP_005564.1	lamin-B1 isoform 1	LMNB1
NP_116126.2	lamin-B2	LMNB2
NP_005551.3	laminin subunit alpha-5 precursor	LAMA5
NP_002282.2	laminin subunit beta-1 precursor	LAMB1
NP_002284.3	laminin subunit gamma-1 precursor	LAMC1
NP_006050.3	laminin subunit gamma-3 precursor	LAMC3
NP_056238.2	L-aminoadipate-semialdehyde dehydrogenase-phosphopantetheinyl transferase	AASDHPPT
NP_001130046.1	lanC-like protein 1	LANCL1
NP_061167.1	lanC-like protein 2	LANCL2
NP_001138909.1	lanosterol synthase isoform 3	LSS
NP_060548.2	la-related protein 1B isoform 1	LARP1B
NP_001186626.1	large proline-rich protein BAG6 isoform c	BAG6
NP_079356.3	L-asparaginase	ASRGL1
NP_055875.1	late secretory pathway protein AVL9 homolog	AVL9
NP_056051.2	latrophilin-3 precursor	LPHN3
NP_055969.1	LDLR chaperone MESD	MESDC2
NP_057485.2	lethal, Chr 7, Rinchik 6	C11orf73
NP_573566.2	leucine-rich PPR motif-containing protein, mitochondrial precursor	LRPPRC
NP_065761.1	leucine-rich repeat-containing protein 47	LRRC47
NP_060979.2	leucine-rich repeat-containing protein 59	LRRC59
NP_064502.9	leucyl-tRNA synthetase, cytoplasmic	LARS
NP_000886.1	leukotriene A-4 hydrolase	LTA4H
NP_006139.1	LIM and SH3 domain protein 1	LASP1
NP_001107019.1	LIM domain and actin-binding protein 1 isoform 3	LIMA1
NP_003884.1	LIM domain-binding protein 1 isoform 3	LDB1
NP_149977.2	lipase maturation factor 2	LMF2
NP_001185845.1	liprin-beta-1 isoform 4	PPFIBP1
NP_005557.1	L-lactate dehydrogenase A chain isoform 1	LDHA
NP_002291.1	L-lactate dehydrogenase B chain	LDHB
NP_004784.2	lon protease homolog, mitochondrial precursor	LONP1
NP_004448.2	long-chain-fatty-acid--CoA ligase 3	ACSL3
NP_001035739.1	low molecular weight phosphotyrosine protein phosphatase isoform d	ACP1
NP_001182732.1	low-density lipoprotein receptor isoform 6 precursor	LDLR
NP_057508.2	luc7-like protein 3	LUC7L3
NP_003133.1	lupus La protein	SSB
NP_001182147.1	L-xylulose reductase isoform 2	DCXR
NP_060962.2	lymphokine-activated killer T-cell-originated protein kinase	PBK
NP_001018065.1	lys-63-specific deubiquitinase BRCC36 isoform 2	BRCC3
NP_057688.2	lysine-specific demethylase 3B	KDM3B
NP_055828.2	lysine-specific histone demethylase 1A isoform b	KDM1A
NP_079106.3	lysophosphatidylcholine acyltransferase 1	LPCAT1
NP_620149.1	lysophospholipase-like protein 1	LYPLAL1
NP_001139554.1	lysophospholipid acyltransferase 7 isoform 3	MBOAT7
NP_000143.2	lysosomal alpha-glucosidase preproprotein	GAA
NP_005031.1	lysosomal Pro-X carboxypeptidase isoform 1 preproprotein	PRCP
NP_005497.1	lysosome membrane protein 2 isoform 1	SCARB2
NP_005552.3	lysosome-associated membrane glycoprotein 1 precursor	LAMP1
NP_002285.1	lysosome-associated membrane glycoprotein 2 isoform A precursor	LAMP2
NP_005539.1	lysyl-tRNA synthetase isoform 2	KARS
NP_005202.2	macrophage colony-stimulating factor 1 receptor precursor	CSF1R
NP_002406.1	macrophage migration inhibitory factor	MIF
NP_057531.2	MAGUK p55 subfamily member 6	MPP6
NP_005908.1	malate dehydrogenase, cytoplasmic isoform 2	MDH1
NP_005909.2	malate dehydrogenase, mitochondrial precursor	MDH2
NP_055545.1	malectin precursor	MLEC

Table 1 continued..

NP_995319.1	mannose-1-phosphate guanyltransferase alpha	GMPPA
NP_001139630.1	mannosyl-oligosaccharide glucosidase isoform 2	MOGS
NP_653179.1	MAPK-interacting and spindle-stabilizing protein-like	MAPK1IP1L
NP_075385.1	MARCKS-related protein	MARCKSL1
NP_001121362.1	maspardin isoform b	SPG21
NP_954659.1	matrin-3 isoform a	MATR3
NP_940932.2	matrix-remodeling-associated protein 7 isoform 3	MXRA7
NP_055456.2	mediator of DNA damage checkpoint protein 1	MDC1
NP_060108.2	mediator of RNA polymerase II transcription subunit 18	MED18
NP_000007.1	medium-chain specific acyl-CoA dehydrogenase, mitochondrial isoform a precursor	ACADM
NP_008917.3	melanoma-associated antigen D1 isoform b	MAGED1
NP_957516.1	melanoma-associated antigen D2	MAGED2
NP_619649.1	melanoma-associated antigen G1	NDNL2
NP_006658.1	membrane-associated progesterone receptor component 1	PGRMC1
NP_006311.2	membrane-associated progesterone receptor component 2	PGRMC2
NP_006001.3	mesencephalic astrocyte-derived neurotrophic factor precursor	MANF
NP_803490.1	mesoderm-specific transcript homolog protein isoform b	MEST
NP_004730.2	metastasis-associated protein MTA2	MTA2
NP_006545.1	metaxin-2	MTX2
NP_004981.2	methionyl-tRNA synthetase, cytoplasmic	MARS
NP_003917.1	methyl-CpG-binding domain protein 3	MBD3
NP_000422.1	mevalonate kinase	MVK
NP_005917.2	microfibrillar-associated protein 1	MFAP1
NP_036222.3	microtubule-actin cross-linking factor 1 isoform a	MACF1
NP_002364.5	microtubule-associated protein 1A	MAP1A
NP_005900.2	microtubule-associated protein 1B	MAP1B
NP_002365.3	microtubule-associated protein 2 isoform 1	MAP2
NP_114035.2	microtubule-associated protein 2 isoform 4	MAP2
NP_001127836.1	microtubule-associated protein 4 isoform 4	MAP4
NP_036457.1	microtubule-associated protein RP/EB family member 1	MAPRE1
NP_058525.1	microtubule-associated protein tau isoform 4	MAPT
NP_073729.1	microtubule-associated proteins 1A/1B light chain 3B	MAP1LC3B
NP_079110.1	mini-chromosome maintenance complex-binding protein	MCMBP
NP_055157.1	mitochondrial carrier homolog 2	MTCH2
NP_057152.2	mitochondrial fission 1 protein	FIS1
NP_036590.1	mitochondrial import inner membrane translocase subunit Tim13	TIMM13
NP_064628.1	mitochondrial import receptor subunit TOM22 homolog	TOMM22
NP_060777.3	mitochondrial Rho GTPase 1 isoform 3	RHOT1
NP_055975.1	mitochondrial-processing peptidase subunit alpha precursor	PMPCA
NP_004270.2	mitochondrial-processing peptidase subunit beta precursor	PMPCB
NP_002736.3	mitogen-activated protein kinase 1	MAPK1
NP_001103361.1	mitogen-activated protein kinase 3 isoform 3	MAPK3
NP_001007794.1	mitotic checkpoint protein BUB3 isoform b	BUB3
NP_057146.1	mitotic spindle-associated MMXD complex subunit MIP18	FAM96B
NP_071757.4	MMS19 nucleotide excision repair protein homolog	MMS19
NP_002435.1	moesin	MSN
NP_001035937.1	monoacylglycerol lipase ABHD12 isoform a	ABHD12
NP_001159968.1	monocarboxylate transporter 1	SLC16A1
NP_150638.1	MORF4 family-associated protein 1	MRFAP1
NP_005894.3	mothers against decapentaplegic homolog 5	SMAD5
NP_060691.2	mps one binder kinase activator-like 1B	MOBKL1B
NP_570719.1	mps one binder kinase activator-like 2A	MOBKL2A
NP_006443.1	multifunctional protein ADE2 isoform 2	PAICS
NP_001164980.1	multiple coagulation factor deficiency protein 2 isoform B	MCFD2
NP_055335.2	myb-binding protein 1A isoform 2	MYBBP1A

Table 1 continued..

NP_057216.2	myelin expression factor 2	MYEF2
NP_066299.2	myosin light polypeptide 6 isoform 1	MYL6
NP_006462.1	myosin regulatory light chain 12A	MYL12A
NP_005955.1	myosin-10	MYH10
NP_079005.3	myosin-14 isoform 2	MYH14
NP_002464.1	myosin-9	MYH9
NP_036355.2	myosin-Ib isoform 2	MYO1B
NP_001123537.1	myosin-IXb isoform 2	MYO9B
NP_001135967.1	myosin-Va isoform 2	MYO5A
NP_665807.1	myotrophin	MTPN
NP_002347.5	myristoylated alanine-rich C-kinase substrate	MARCKS
NP_001136026.1	N(2),N(2)-dimethylguanosine tRNA methyltransferase isoform 2	TRMT1
NP_036269.1	N(G),N(G)-dimethylarginine dimethylaminohydrolase 1 isoform 1	DDAH1
NP_039268.1	N(G),N(G)-dimethylarginine dimethylaminohydrolase 2	DDAH2
NP_004243.1	Na(+)/H(+) exchange regulatory cofactor NHE-RF1	SLC9A3R1
NP_002067.1	N-acetylglucosamine-6-sulfatase precursor	GNS
NP_001137502.1	N-acetyltransferase 10 isoform b	NAT10
NP_001017420.1	N-acetyltransferase ESCO2	ESCO2
NP_612202.1	NACHT, LRR and PYD domains-containing protein 6	NLRP6
NP_001020605.1	NAD(P)H dehydrogenase [quinone] 1 isoform c	NQO1
NP_001017524.1	NAD-dependent deacetylase sirtuin-3, mitochondrial isoform b	SIRT3
NP_001161807.1	NAD-dependent malic enzyme, mitochondrial isoform 2 precursor	ME2
NP_004991.1	NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 5	NDUFA5
NP_066552.2	NADH dehydrogenase [ubiquinone] flavoprotein 2, mitochondrial precursor	NDUFV2
NP_004542.1	NADH dehydrogenase [ubiquinone] iron-sulfur protein 3, mitochondrial precursor	NDUFS3
NP_002486.1	NADH dehydrogenase [ubiquinone] iron-sulfur protein 4, mitochondrial precursor	NDUFS4
NP_077718.3	NADH dehydrogenase [ubiquinone] iron-sulfur protein 7, mitochondrial precursor	NDUFS7
NP_002487.1	NADH dehydrogenase [ubiquinone] iron-sulfur protein 8, mitochondrial precursor	NDUFS8
NP_001123291.1	NADH-cytochrome b5 reductase 3 isoform 2	CYB5R3
NP_001186911.1	NADH-ubiquinone oxidoreductase 75 kDa subunit, mitochondrial isoform 3	NDUFS1
NP_000932.3	NADPH--cytochrome P450 reductase	POR
NP_476516.1	N-alpha-acetyltransferase 15, NatA auxiliary subunit	NAA15
NP_005585.1	nascent polypeptide-associated complex subunit alpha isoform b	NACA
NP_038464.1	nck-associated protein 1 isoform 1	NCKAP1
NP_006147.1	NEDD8 precursor	NEDD8
NP_003960.1	NEDD8-conjugating enzyme Ubc12	UBE2M
NP_001152763.1	NEDD9-interacting protein with calponin homology and LIM domains isoform 2	MICAL1
NP_005654.3	negative elongation factor A	WHSC2
NP_056271.2	negative elongation factor B	COBRA1
NP_006608.1	nestin	NES
NP_037481.1	neudesin precursor	NENF
NP_115984.3	neurabin-2	PPP1R9B
NP_000606.3	neural cell adhesion molecule 1 isoform 1 precursor	NCAM1
NP_001137435.1	neural cell adhesion molecule L1 isoform 3 precursor	L1CAM
NP_001611.1	neuroblast differentiation-associated protein AHNAK isoform 1	AHNAK
NP_056993.2	neuroblastoma-amplified sequence	NBAS
NP_006149.2	neurofilament light polypeptide	NEFL
NP_065777.1	neurolysin, mitochondrial precursor	NLN
NP_002036.1	neuromodulin isoform 2	GAP43
NP_963886.1	neuronal membrane glycoprotein M6-a isoform 3	GPM6A
NP_835364.1	neuronal migration protein doublecortin isoform c	DCX
NP_003369.2	neurosecretory protein VGF precursor	VGF
NP_938148.1	neutral alpha-glucosidase AB isoform 2	GANAB
NP_003029.2	neutral amino acid transporter A isoform 1	SLC1A4
NP_001165780.1	nexilin isoform 2	NEXN

Table 1 continued..

NP_066363.1	NFX1-type zinc finger-containing protein 1	ZNFX1
NP_940916.2	NHL repeat-containing protein 2	NHLRC2
NP_004999.1	NHP2-like protein 1	NHP2L1
NP_001030611.1	niban-like protein 1 isoform 2	FAM129B
NP_005737.1	nicotinamide phosphoribosyltransferase precursor	NAMPT
NP_055113.2	nicotinate-nucleotide pyrophosphorylase [carboxylating]	QPRT
NP_000262.2	Niemann-Pick C1 protein precursor	NPC1
NP_001172021.1	nitrilase homolog 1 isoform 2	NIT1
NP_001018146.1	NME1-NME2 protein	NME1-NME2
NP_004679.2	N-myc-interactor	NMI
NP_775885.1	nodal modulator 2 isoform 2	NOMO2
NP_004956.5	non-histone chromosomal protein HMG-14	HMGN1
NP_031389.3	non-POU domain-containing octamer-binding protein isoform 1	NONO
NP_001007101.1	non-specific lipid-transfer protein isoform 4 proprotein	SCP2
NP_057227.2	NSFL1 cofactor p47 isoform a	NSFL1C
NP_002473.2	nuclear autoantigenic sperm protein isoform 2	NASP
NP_002477.1	nuclear cap-binding protein subunit 1	NCBP1
NP_005587.2	nuclear factor 1 B-type isoform 3	NFIB
NP_995315.1	nuclear factor 1 C-type isoform 2	NFIC
NP_006591.1	nuclear migration protein nudC	NUDC
NP_006176.2	nuclear mitotic apparatus protein 1	NUMA1
NP_065134.1	nuclear pore complex protein Nup107	NUP107
NP_060700.2	nuclear pore complex protein Nup133	NUP133
NP_005115.2	nuclear pore complex protein Nup153	NUP153
NP_705618.1	nuclear pore complex protein Nup155 isoform 1	NUP155
NP_056046.1	nuclear pore complex protein Nup160	NUP160
NP_055950.1	nuclear pore complex protein Nup205	NUP205
NP_005076.3	nuclear pore complex protein Nup214	NUP214
NP_079120.1	nuclear pore complex protein Nup85	NUP85
NP_002523.2	nuclear pore complex protein Nup88	NUP88
NP_055484.3	nuclear pore complex protein Nup93 isoform 1	NUP93
NP_057637.2	nuclear pore glycoprotein p62	NUP62
NP_060391.2	nuclear protein localization protein 4 homolog	NPLOC4
NP_066018.1	nuclear receptor coactivator 5	NCOA5
NP_037524.1	nuclear receptor-binding protein	NRBP1
NP_005787.1	nuclear transport factor 2	NUTF2
NP_057562.3	nuclear-interacting partner of ALK	ZC3HC1
NP_004550.2	nuclease-sensitive element-binding protein 1	YBX1
NP_006175.2	nucleobindin-1 precursor	NUCB1
NP_005004.1	nucleobindin-2 precursor	NUCB2
NP_004732.2	nucleolar and coiled-body phosphoprotein 1	NOLC1
NP_055640.2	nucleolar pre-ribosomal-associated protein 1	URB1
NP_006383.2	nucleolar protein 56	NOP56
NP_057018.1	nucleolar protein 58	NOP58
NP_075068.2	nucleolar protein 6 alpha isoform	NOL6
NP_001070151.1	nucleolar transcription factor 1 isoform b	UBTF
NP_005372.2	nucleolin	NCL
NP_003243.1	nucleolysin TIAR isoform 1	TIAL1
NP_954654.1	nucleophosmin isoform 2	NPM1
NP_008924.1	nucleoplasmin-3	NPM3
NP_001162023.1	nucleoporin NDC1 isoform 2	TMEM48
NP_056169.1	nucleoporin NUP188 homolog	NUP188
NP_003283.2	nucleoprotein TPR	TPR
NP_071908.2	nucleoredoxin isoform 1	NXN
NP_000260.1	nucleoside diphosphate kinase A isoform b	NME1

Table 1 continued..

NP_005000.1	nucleoside diphosphate kinase, mitochondrial precursor	NME4
NP_004528.1	nucleosome assembly protein 1-like 1	NAP1L1
NP_005960.1	nucleosome assembly protein 1-like 4	NAP1L4
NP_660309.1	nudC domain-containing protein 2	NUDCD2
NP_056147.2	nudC domain-containing protein 3	NUDCD3
NP_037473.3	obg-like ATPase 1 isoform 1	OLA1
NP_001004456.1	olfactory receptor 1M1	OR1M1
NP_064587.1	omega-amidase NIT2	NIT2
NP_000265.1	ornithine aminotransferase, mitochondrial isoform 1 precursor	OAT
NP_001188411.1	oxysterol-binding protein-related protein 6 isoform e	OSBPL6
NP_001003712.1	oxysterol-binding protein-related protein 8 isoform b	OSBPL8
NP_066997.3	p30 DBC protein	KIAA1967
NP_001159732.1	pachytene checkpoint protein 2 homolog isoform 2	TRIP13
NP_000301.1	palmitoyl-protein thioesterase 1 isoform 1 precursor	PPT1
NP_060686.1	pantothenate kinase 4	PANK4
NP_009188.1	paraneoplastic antigen Ma2	PNMA2
NP_001035879.1	paraspeckle component 1	PSPC1
NP_002815.3	parathyrosin	PTMS
NP_001137325.1	partner of Y14 and mago isoform 2	WIBG
NP_066967.3	PC4 and SFRS1-interacting protein isoform 1	PSIP1
NP_060856.2	PCI domain-containing protein 2	PCID2
NP_006448.3	PDZ and LIM domain protein 5 isoform a	PDLIM5
NP_005707.1	PDZ domain-containing protein GIPC1 isoform 1	GIPC1
NP_066953.1	peptidyl-prolyl cis-trans isomerase A	PPIA
NP_000933.1	peptidyl-prolyl cis-trans isomerase B precursor	PPIB
NP_982281.1	peptidyl-prolyl cis-trans isomerase E isoform 2	PPIE
NP_068758.3	peptidyl-prolyl cis-trans isomerase FKBP10 precursor	FKBP10
NP_463460.1	peptidyl-prolyl cis-trans isomerase FKBP1A isoform a	FKBP1A
NP_004461.2	peptidyl-prolyl cis-trans isomerase FKBP2 precursor	FKBP2
NP_002004.1	peptidyl-prolyl cis-trans isomerase FKBP3	FKBP3
NP_002005.1	peptidyl-prolyl cis-trans isomerase FKBP4	FKBP4
NP_009201.2	peptidyl-prolyl cis-trans isomerase FKBP9 precursor	FKBP9
NP_004783.2	peptidyl-prolyl cis-trans isomerase G	PPIG
NP_006212.1	peptidyl-prolyl cis-trans isomerase NIMA-interacting 1	PIN1
NP_057143.1	peptidyl-prolyl cis-trans isomerase-like 1	PPIL1
NP_570981.1	peptidyl-prolyl cis-trans isomerase-like 3 isoform PPIL3b	PPIL3
NP_006188.3	pericentriolar material 1 protein	PCM1
NP_001157666.1	perilipin-3 isoform 3	PLIN3
NP_001119527.1	peripheral plasma membrane protein CASK isoform 3	CASK
NP_859048.1	peroxiredoxin-1	PRDX1
NP_005800.3	peroxiredoxin-2 isoform a	PRDX2
NP_006397.1	peroxiredoxin-4	PRDX4
NP_036226.1	peroxiredoxin-5, mitochondrial isoform a precursor	PRDX5
NP_004896.1	peroxiredoxin-6	PRDX6
NP_004026.2	peroxisomal acyl-coenzyme A oxidase 1 isoform a	ACOX1
NP_001180573.1	peroxisomal biogenesis factor 19 isoform c	PEX19
NP_004556.1	peroxisomal membrane protein PEX14	PEX14
NP_001186221.1	peroxisomal multifunctional enzyme type 2 isoform 3	HSD17B4
NP_001096618.1	PERQ amino acid-rich with GYF domain-containing protein 2 isoform c	GIGYF2
NP_115711.2	PHD finger protein 6 isoform 2	PHF6
NP_004452.1	phenylalanyl-tRNA synthetase alpha chain	FARSA
NP_005678.3	phenylalanyl-tRNA synthetase beta chain	FARSB
NP_998776.1	phosphate carrier protein, mitochondrial isoform b precursor	SLC25A3
NP_002558.1	phosphatidylethanolamine-binding protein 1 preproprotein	PEBP1
NP_054735.3	phosphatidylinositol phosphatase SAC1	SACM1L

Table 1 continued..

NP_065871.2	phosphatidylinositol 3,4,5-trisphosphate-dependent Rac exchanger 1 protein	PREX1
NP_036531.1	phosphatidylinositol transfer protein beta isoform	PITPNB
NP_001558.3	phosphatidylinositol-3,4,5-trisphosphate 5-phosphatase 2	INPPL1
NP_002636.2	phosphatidylinositol-4-phosphate 3-kinase C2 domain-containing subunit alpha	PIK3C2A
NP_003550.1	phosphatidylinositol-5-phosphate 4-kinase type-2 beta	PIP4K2B
NP_001008660.1	phosphatidylinositol-binding clathrin assembly protein isoform 2	PICALM
NP_110410.1	phosphatidylserine synthase 2	PTDSS2
NP_056414.1	phosphoacetylglucosamine mutase isoform 2	PGM3
NP_002624.2	phosphoglucomutase-1 isoform 1	PGM1
NP_060760.2	phosphoglucomutase-2	PGM2
NP_000282.1	phosphoglycerate kinase 1	PGK1
NP_620061.2	phosphoglycerate kinase 2	PGK2
NP_002620.1	phosphoglycerate mutase 1	PGAM1
NP_001035830.1	phosphoglycolate phosphatase	PGP
NP_001026859.1	phospholipase A-2-activating protein	PLAA
NP_001026866.1	phospholipase D3	PLD3
NP_006547.1	phosphomevalonate kinase	PMVK
NP_002757.2	phosphoribosyl pyrophosphate synthase-associated protein 1	PRPSAP1
NP_002758.1	phosphoribosyl pyrophosphate synthase-associated protein 2 isoform 1	PRPSAP2
NP_036525.1	phosphoribosylformylglycinamide synthase	PFAS
NP_478059.1	phosphoserine aminotransferase isoform 1	PSAT1
NP_004568.2	phosphoserine phosphatase	PSPH
NP_060386.1	PIH1 domain-containing protein 1	PIH1D1
NP_001018119.1	pirin	PIR
NP_056455.3	plasminogen activator inhibitor 1 RNA-binding protein isoform 4	SERBP1
NP_000421.1	platelet-activating factor acetylhydrolase IB subunit alpha	PAFAH1B1
NP_002563.1	platelet-activating factor acetylhydrolase IB subunit beta isoform a	PAFAH1B2
NP_002564.1	platelet-activating factor acetylhydrolase IB subunit gamma	PAFAH1B3
NP_958783.1	plectin isoform 1d	PLEC
NP_036533.2	plexin-B2 precursor	PLXNB2
NP_060685.2	PNMA-like protein 1 isoform a	PNMAL1
NP_056535.1	podocalyxin-like protein 2 precursor	PODXL2
NP_665739.3	pogo transposable element with ZNF domain isoform 3	POGZ
NP_001609.2	poly [ADP-ribose] polymerase 1	PARP1
NP_060295.1	poly(ADP-ribose) glycohydrolase ARH3	ADPRHL2
NP_006187.2	poly(rC)-binding protein 1	PCBP1
NP_001092090.1	poly(rC)-binding protein 2 isoform c	PCBP2
NP_001129505.1	poly(U)-binding-splicing factor PUF60 isoform c	PUF60
NP_002559.2	polyadenylate-binding protein 1	PABPC1
NP_004634.1	polyadenylate-binding protein 2	PABPN1
NP_001129126.1	polyadenylate-binding protein 4 isoform 3	PABPC4
NP_899152.1	polyadenylate-binding protein-interacting protein 1 isoform 3	PAIP1
NP_006306.2	polycomb group RING finger protein 3	PCGF3
NP_078930.3	polynucleotide 5'-hydroxyl-kinase NOL9	NOL9
NP_004472.1	polypeptide N-acetylgalactosaminyltransferase 2	GALNT2
NP_114368.1	polypyrimidine tract-binding protein 1 isoform c	PTBP1
NP_001019553.1	porphobilinogen deaminase isoform 2	HMBS
NP_001093241.1	POTE ankyrin domain family member F	POTEF
NP_006398.1	PRA1 family protein 3	ARL6IP5
NP_065385.2	pre-B-cell leukemia transcription factor-interacting protein 1	PBXIP1
XP_003119945.2	PREDICTED: hypothetical protein LOC100287063	LOC100287063
XP_001129774.2	PREDICTED: peptidyl-prolyl cis-trans isomerase A-like	LOC650157
XP_003120106.1	PREDICTED: protein FAM115A-like	LOC100508781
XP_003119132.1	PREDICTED: serine/arginine-rich splicing factor 10-like	LOC100505793
XP_003403752.1	PREDICTED: UPF0575 protein C19orf67	C19orf67

Table 1 continued..

NP_036526.2	prefoldin subunit 2	PFDN2
NP_003363.1	prefoldin subunit 3	VBP1
NP_002614.2	prefoldin subunit 4	PFDN4
NP_002615.2	prefoldin subunit 5 isoform alpha	PFDN5
NP_001172110.1	prefoldin subunit 6	PFDN6
NP_733821.1	prelamin-A/C isoform 1 precursor	LMNA
NP_005563.1	prelamin-A/C isoform 2	LMNA
NP_001128410.1	pre-mRNA 3'-end-processing factor FIP1 isoform 3	FIP1L1
NP_055317.1	pre-mRNA-processing factor 19	PRPF19
NP_060362.3	pre-mRNA-processing factor 40 homolog A	PRPF40A
NP_036601.2	pre-mRNA-processing factor 6	PRPF6
NP_006436.3	pre-mRNA-processing-splicing factor 8	PRPF8
NP_065994.1	pre-mRNA-splicing factor CWC22 homolog	CWC22
NP_006416.3	pre-mRNA-splicing factor SLU7	SLU7
NP_057381.3	prenylcysteine oxidase 1 precursor	PCYOX1
NP_076933.3	prenylcysteine oxidase-like precursor	PCYOX1L
NP_002769.1	proactivator polypeptide isoform a preproprotein	PSAP
NP_061176.3	probable 2-oxoglutarate dehydrogenase E1 component DHKTD1, mitochondrial precursor	DHTKD1
NP_006377.2	probable ATP-dependent RNA helicase DDX17 isoform 1	DDX17
NP_004809.2	probable ATP-dependent RNA helicase DDX23	DDX23
NP_004387.1	probable ATP-dependent RNA helicase DDX5	DDX5
NP_004388.2	probable ATP-dependent RNA helicase DDX6	DDX6
NP_065143.2	probable cation-transporting ATPase 13A1	ATP13A1
NP_078813.1	probable cysteinyl-tRNA synthetase, mitochondrial precursor	CARS2
NP_065108.1	probable fructose-2,6-bisphosphatase TIGAR	C12orf5
NP_036340.1	probable histidyl-tRNA synthetase, mitochondrial precursor	HARS2
NP_060959.2	probable histone-lysine N-methyltransferase ASH1L	ASH1L
NP_057086.2	probable saccharopine dehydrogenase	SCCPDH
NP_060277.1	probable tRNA threonylcarbamoyladenosine biosynthesis protein OSGEP	OSGEP
NP_001034680.2	probable ubiquitin carboxyl-terminal hydrolase FAF-X isoform 4	USP9X
NP_078932.2	procollagen galactosyltransferase 1 precursor	GLT25D1
NP_055916.1	procollagen galactosyltransferase 2 precursor	GLT25D2
NP_001075.1	procollagen-lysine,2-oxoglutarate 5-dioxygenase 3 precursor	PLOD3
NP_005013.1	profilin-1	PFN1
NP_002619.1	profilin-2 isoform b	PFN2
NP_037506.2	programmed cell death 6-interacting protein isoform 1	PDCD6IP
NP_665858.1	programmed cell death protein 10	PDCD10
NP_001186421.1	programmed cell death protein 4 isoform 3	PDCD4
NP_004699.1	programmed cell death protein 5	PDCD5
NP_037364.1	programmed cell death protein 6	PDCD6
NP_002625.1	prohibitin	PHB
NP_001138303.1	prohibitin-2 isoform 1	PHB2
NP_002583.1	proliferating cell nuclear antigen	PCNA
NP_006182.2	proliferation-associated protein 2G4	PA2G4
NP_009129.1	proline synthase co-transcribed bacterial homolog protein	PROSC
NP_002323.2	prolow-density lipoprotein receptor-related protein 1 precursor	LRP1
NP_001139761.1	prolyl 3-hydroxylase 1 isoform 2 precursor	LEPRE1
NP_001136068.1	prolyl 4-hydroxylase subunit alpha-1 isoform 3 precursor	P4HA1
NP_002717.3	prolyl endopeptidase	PREP
NP_079348.1	prostaglandin E synthase 2	PTGES2
NP_006592.3	prostaglandin E synthase 3	PTGES3
NP_001182670.1	prostamide/prostaglandin F synthase isoform f	C1orf93
NP_079431.1	proteasomal ATPase-associated factor 1	PAAF1
NP_008933.2	proteasomal ubiquitin receptor ADRM1 precursor	ADRM1
NP_006254.1	proteasome activator complex subunit 1 isoform 1	PSME1

Table 1 continued..

NP_002809.2	proteasome activator complex subunit 2	PSME2
NP_005780.2	proteasome activator complex subunit 3 isoform 1	PSME3
NP_002777.1	proteasome subunit alpha type-1 isoform 2	PSMA1
NP_002778.1	proteasome subunit alpha type-2	PSMA2
NP_687033.1	proteasome subunit alpha type-3 isoform 2	PSMA3
NP_002780.1	proteasome subunit alpha type-4 isoform 1	PSMA4
NP_002781.2	proteasome subunit alpha type-5 isoform 1	PSMA5
NP_002782.1	proteasome subunit alpha type-6	PSMA6
NP_001020268.1	proteasome subunit alpha type-7-like isoform 3	PSMA8
NP_002784.1	proteasome subunit beta type-1 precursor	PSMB1
NP_002785.1	proteasome subunit beta type-2 isoform 1	PSMB2
NP_002786.2	proteasome subunit beta type-3	PSMB3
NP_002787.2	proteasome subunit beta type-4	PSMB4
NP_002788.1	proteasome subunit beta type-5 isoform 1	PSMB5
NP_002789.1	proteasome subunit beta type-6 precursor	PSMB6
NP_002790.1	proteasome subunit beta type-7 proprotein	PSMB7
NP_004150.1	proteasome subunit beta type-8 isoform E1 proprotein	PSMB8
NP_001073867.1	proteasome-associated protein ECM29 homolog	KIAA0368
NP_006809.1	protein AF1q	MLLT11
NP_001070957.1	protein ALEX isoform g	GNAS
NP_065965.4	protein ALO17 isoform 1	RNF213
NP_938074.2	protein arginine N-methyltransferase 1 isoform 3	PRMT1
NP_001034708.1	protein arginine N-methyltransferase 5 isoform b	PRMT5
NP_060932.2	protein BRICK1	BRK1
NP_060059.1	protein BTG4	BTG4
NP_003901.2	protein BUD31 homolog	BUD31
NP_612434.1	protein C10	C12orf57
NP_060366.1	protein C20orf11	C20orf11
NP_055070.1	protein canopy homolog 2 isoform 1 precursor	CNPY2
NP_689968.1	protein canopy homolog 4 precursor	CNPY4
NP_001127895.1	protein CDV3 homolog isoform c	CDV3
NP_065941.2	protein CIP2A	KIAA1524
NP_689708.1	protein cornichon homolog 3	CNIH3
NP_057005.1	protein CutA isoform 2	CUTA
NP_001128181.1	protein DEK isoform 2	DEK
NP_001073280.1	protein diaphanous homolog 1 isoform 2	DIAPH1
NP_005304.3	protein disulfide-isomerase A3 precursor	PDIA3
NP_004902.1	protein disulfide-isomerase A4 precursor	PDIA4
NP_005733.1	protein disulfide-isomerase A6 precursor	PDIA6
NP_000909.2	protein disulfide-isomerase precursor	P4HB
NP_061895.3	protein disulfide-isomerase TMX3 precursor	TMX3
NP_009193.2	protein DJ-1	PARK7
NP_115963.1	protein dpy-30 homolog	DPY30
NP_001929.1	protein Dr1	DR1
NP_060682.2	protein enabled homolog isoform b	ENAH
NP_005561.1	protein ERGIC-53 precursor	LMAN1
NP_003815.1	protein FADD	FADD
NP_940890.3	protein FAM83H	FAM83H
NP_056290.3	protein FAM98A	FAM98A
NP_003571.2	protein FAN isoform 1	NSMAF
NP_037397.2	protein fat-free homolog	C11orf2
NP_055845.1	protein furry homolog-like	FRYL
NP_115786.1	protein Hook homolog 3	HOOK3
NP_001171900.1	protein kinase C and casein kinase substrate in neurons protein 2 isoform B	PAC SIN2
NP_997700.1	protein kinase C beta type isoform 1	PRKCB

Table 1 continued..

NP_898869.1	protein kinase C-binding protein 1 isoform c	ZMYND8
NP_001164120.1	protein LAS1 homolog isoform 2	LAS1L
NP_085153.1	protein lunapark	KIAA1715
NP_848927.2	protein LYRIC	MTDH
NP_115744.2	protein LZIC	LZIC
NP_002361.1	protein mago nashi homolog	MAGOH
NP_006087.2	protein NDRG1	NDRG1
NP_001229765.1	protein NDRG4 isoform 3	NDRG4
NP_443198.1	protein Niban isoform 2	FAM129A
NP_001189431.1	protein NipSnap homolog 1 isoform 2	NIPSNAP1
NP_001474.1	protein NipSnap homolog 2 isoform 1	GBAS
NP_057030.3	protein pelota homolog	PELO
NP_001137358.1	protein phosphatase 1 regulatory subunit 12A isoform b	PPP1R12A
NP_619634.1	protein phosphatase 1 regulatory subunit 14B	PPP1R14B
NP_002703.1	protein phosphatase 1 regulatory subunit 7	PPP1R7
NP_055449.1	protein phosphatase 1F	PPM1F
NP_817092.1	protein phosphatase 1G	PPM1G
NP_057231.1	protein phosphatase methylesterase 1	PPME1
NP_055325.2	protein piccolo isoform 2	PCLO
NP_851385.1	protein polybromo-1 isoform 4	PBRM1
NP_570721.1	protein PRRC1	PRRC1
NP_996735.1	protein quaking isoform HQK-6	QKI
NP_061185.1	protein RCC2	RCC2
NP_055776.1	protein RUFY3 isoform 2	RUFY3
NP_005611.1	protein S100-A11	S100A11
NP_005970.1	protein S100-A13	S100A13
NP_525127.1	protein S100-A16	S100A16
NP_055439.1	protein S100-A6	S100A6
NP_006263.1	protein S100-B	S100B
NP_056171.2	protein scribble homolog isoform b	SCRIB
NP_899195.1	protein SEC13 homolog isoform 1	SEC13
NP_003002.2	protein SET isoform 2	SET
NP_115571.1	protein SON isoform B	SON
NP_005626.1	protein SSX1	SSX1
NP_001182408.1	protein TFG isoform 2	TFG
NP_006355.2	protein transport protein Sec23A	SEC23A
NP_004913.2	protein transport protein Sec24C	SEC24C
NP_001070674.1	protein transport protein Sec31A isoform 4	SEC31A
NP_037468.1	protein transport protein Sec61 subunit alpha isoform 1	SEC61A1
NP_006799.1	protein transport protein Sec61 subunit beta	SEC61B
NP_003301.1	protein TSSC1	TSSC1
NP_065710.1	protein tweety homolog 1 isoform 1	TTYH1
NP_116035.5	protein tweety homolog 2 isoform 1	TTYH2
NP_079526.1	protein tweety homolog 3	TTYH3
NP_001074002.1	protein unc-119 homolog B	UNC119B
NP_001034764.1	protein unc-45 homolog A isoform 3	UNC45A
NP_060522.3	protein VAC14 homolog	VAC14
NP_005380.2	protein-L-isoaspartate(D-aspartate) O-methyltransferase	PCMT1
NP_775267.1	protein-tyrosine kinase 2-beta isoform b	PTK2B
NP_002814.3	prothymosin alpha isoform 2	PTMA
NP_002580.2	protocadherin-7 isoform a precursor	PCDH7
NP_001171606.1	pseudouridine-5'-monophosphatase isoform c	HDHD1
NP_000272.1	pterin-4-alpha-carbinolamine dehydratase precursor	PCBD1
NP_000261.2	purine nucleoside phosphorylase	PNP
NP_006301.3	puromycin-sensitive aminopeptidase	NPEPPS

Table 1 continued..

NP_001229602.1	putative adenosylhomocysteinase 2 isoform b	AHCYL1
NP_001186628.1	putative ATP-dependent RNA helicase DHX33 isoform 2	DHX33
NP_057038.2	putative deoxyribose-phosphate aldolase	DERA
NP_078994.3	putative GTP-binding protein Parf isoform 1	C9orf86
NP_001349.2	putative pre-mRNA-splicing factor ATP-dependent RNA helicase DHX15	DHX15
NP_006734.1	putative RNA-binding protein 3	RBM3
NP_057103.2	putative RNA-binding protein Luc7-like 2	LUC7L2
NP_060117.3	putative rRNA methyltransferase 3	FTSJ3
NP_003672.1	pyridoxal kinase	PDXK
NP_064711.1	pyridoxal phosphate phosphatase	PDXP
NP_055842.2	pyridoxal-dependent decarboxylase domain-containing protein 1	PDXDC1
NP_060182.1	pyroglutamyl-peptidase 1	PGPEP1
NP_037460.2	pyrroline-5-carboxylate reductase 2	PYCR2
NP_001166927.1	pyruvate dehydrogenase E1 component subunit alpha, somatic form, mitochondrial isoform 4 precursor	PDHA1
NP_001166939.1	pyruvate dehydrogenase E1 component subunit beta, mitochondrial isoform 2 precursor	PDHB
NP_002645.3	pyruvate kinase isozymes M1/M2 isoform a	PKM2
NP_001193726.1	pyruvate kinase isozymes M1/M2 isoform d	PKM2
NP_001123515.1	quinone oxidoreductase isoform b	CRYZ
NP_001484.1	rab GDP dissociation inhibitor alpha	GDI1
NP_001485.2	rab GDP dissociation inhibitor beta isoform 1	GDI2
NP_001077054.1	rab GTPase-binding effector protein 1 isoform 2	RABEP1
NP_036365.1	rab3 GTPase-activating protein catalytic subunit isoform 2	RAB3GAP1
NP_036546.2	rab3 GTPase-activating protein non-catalytic subunit	RAB3GAP2
NP_068749.3	RAD50-interacting protein 1	RINT1
NP_002897.1	radixin	RDX
NP_068805.1	regulator complex protein LAMTOR3 isoform 1	LAMTOR3
NP_001122089.1	ralBP1-associated Eps domain-containing protein 1 isoform b	REPS1
NP_002874.1	ran GTPase-activating protein 1	RANGAP1
NP_015559.2	ran-binding protein 3 isoform RANBP3-b	RANBP3
NP_001230131.1	ran-binding protein 6 isoform 2	RANBP6
NP_002873.1	ran-specific GTPase-activating protein	RANBP1
NP_066982.3	rap1 GTPase-GDP dissociation stimulator 1 isoform 2	RAP1GDS1
NP_072179.1	ras GTPase-activating protein 1 isoform 2	RASA1
NP_005745.1	ras GTPase-activating protein-binding protein 1	G3BP1
NP_987100.1	ras GTPase-activating protein-binding protein 2 isoform b	G3BP2
NP_003861.1	ras GTPase-activating-like protein IQGAP1	IQGAP1
NP_689937.2	ras suppressor protein 1 isoform 2	RSU1
NP_976241.1	ras-associated and pleckstrin homology domains-containing protein 1 isoform 3	RAPH1
NP_008839.2	ras-related C3 botulinum toxin substrate 1 isoform Rac1	RAC1
NP_071440.1	ras-related GTP-binding protein C	RRAGC
NP_057215.3	ras-related protein Rab-10	RAB10
NP_001193765.1	ras-related protein Rab-11A isoform 2	RAB11A
NP_057406.2	ras-related protein Rab-14	RAB14
NP_004152.1	ras-related protein Rab-1A isoform 1	RAB1A
NP_112243.1	ras-related protein Rab-1B	RAB1B
NP_055814.1	ras-related protein Rab-21	RAB21
NP_001229573.1	ras-related protein Rab-2A isoform b	RAB2A
NP_001156852.1	ras-related protein Rab-2B isoform 2	RAB2B
NP_006859.2	ras-related protein Rab-31	RAB31
NP_006852.1	ras-related protein Rab-35 isoform 1	RAB35
NP_004569.2	ras-related protein Rab-4A	RAB4A
NP_002859.1	ras-related protein Rab-5B	RAB5B
NP_004574.2	ras-related protein Rab-5C isoform b	RAB5C
NP_001230648.1	ras-related protein Rab-6A isoform c	RAB6A

Table 1 continued..

NP_004628.4	ras-related protein Rab-7a	RAB7A
NP_005361.2	ras-related protein Rab-8A	RAB8A
NP_004242.1	ras-related protein Rab-9A	RAB9A
NP_005393.2	ras-related protein Ral-A precursor	RALA
NP_002875.1	ras-related protein Rap-1A precursor	RAP1A
NP_005660.4	receptor expression-enhancing protein 5	REEP5
NP_001193768.1	receptor-type tyrosine-protein phosphatase zeta isoform 3 precursor	PTPRZ1
NP_067038.1	regulation of nuclear pre-mRNA domain-containing protein 1B	RPRD1B
NP_001041664.1	regulator of chromosome condensation isoform c	RCC1
NP_001157260.1	regulator of differentiation 1 isoform 2	ROD1
NP_060615.1	regulator of microtubule dynamics protein 3	FAM82A2
NP_001156506.1	regulatory-associated protein of mTOR isoform 2	RPTOR
NP_057662.3	remodeling and spacing factor 1	RSF1
NP_005756.2	renin receptor	ATP6AP2
NP_852136.1	replication factor C subunit 2 isoform 1	RFC2
NP_853536.2	replication factor C subunit 3 isoform 2	RFC3
NP_002907.1	replication factor C subunit 4	RFC4
NP_001123584.1	replication factor C subunit 5 isoform 3	RFC5
NP_037532.2	replication initiator 1 isoform 1	REPIN1
NP_002938.1	replication protein A 14 kDa subunit	RPA3
NP_002892.1	reticulocalbin-1 precursor	RCN1
NP_002893.1	reticulocalbin-2 precursor	RCN2
NP_006045.1	reticulon-3 isoform a	RTN3
NP_065393.1	reticulon-4 isoform A	RTN4
NP_722550.1	reticulon-4 isoform B	RTN4
NP_000312.2	retinoblastoma-associated protein	RB1
NP_057110.3	retinol dehydrogenase 11	RDH11
NP_004300.1	rho GDP-dissociation inhibitor 1 isoform a	ARHGDI1A
NP_004299.1	rho GTPase-activating protein 1	ARHGAP1
NP_004482.4	rho GTPase-activating protein 35	ARHGAP35
NP_055599.1	rho guanine nucleotide exchange factor 11 isoform 1	ARHGEF11
NP_004714.2	rho guanine nucleotide exchange factor 2 isoform 3	ARHGEF2
NP_004841.2	rho-associated protein kinase 2	ROCK2
NP_786886.1	rho-related GTP-binding protein RhoC precursor	RHOC
NP_006388.2	ribonuclease H2 subunit A	RNASEH2A
NP_002930.2	ribonuclease inhibitor	RNH1
NP_005827.1	ribonuclease UK114	HRSP12
NP_597709.2	ribonucleoprotein PTB-binding 1	RAVER1
NP_001024.1	ribonucleoside-diphosphate reductase large subunit	RRM1
NP_002755.1	ribose-phosphate pyrophosphokinase 1 isoform 1	PRPS1
NP_056474.2	ribosomal L1 domain-containing protein 1	RSL1D1
NP_056139.1	ribosomal RNA-processing protein 8	RRP8
NP_056016.1	ribosome biogenesis protein BOP1	BOP1
NP_004578.2	ribosome-binding protein 1	RRBP1
NP_847884.2	RILP-like protein 1	RILPL1
NP_056355.2	RNA polymerase II-associated protein 1	RPAP1
NP_690595.1	RNA-binding protein 10 isoform 2	RBM10
NP_006038.2	RNA-binding protein 12	RBM12
NP_976324.2	RNA-binding protein 12B	RBM12B
NP_006319.1	RNA-binding protein 14 isoform 1	RBM14
NP_067062.1	RNA-binding protein 25	RBM25
NP_071401.3	RNA-binding protein 26	RBM26
NP_001229529.1	RNA-binding protein 39 isoform d	RBM39
NP_002887.2	RNA-binding protein 4 isoform 1	RBM4
NP_005096.1	RNA-binding protein 8A	RBM8A

Table 1 continued..

NP_001156758.1	RNA-binding protein EWS isoform 4	EWSR1
NP_001164408.1	RNA-binding protein FUS isoform 3	FUS
NP_002433.1	RNA-binding protein Musashi homolog 1	MSI1
NP_733839.1	RNA-binding protein Musashi homolog 2 isoform b	MSI2
NP_054781.1	RNA-binding protein NOB1	NOB1
NP_006482.1	RNA-binding protein Nova-1 isoform 3	NOVA1
NP_002507.1	RNA-binding protein Nova-2	NOVA2
NP_031393.2	RNA-binding protein Raly isoform 2	RALY
NP_542161.1	RNA-binding protein with serine-rich domain 1	RNPS1
NP_001189399.1	RPS10-NUDT3 protein	RPS10-NUDT3
NP_001427.2	rRNA 2'-O-methyltransferase fibrillarin	FBL
NP_001138586.1	RRP12-like protein isoform 2	RRP12
NP_001035541.1	RUN and FYVE domain-containing protein 1 isoform b	RUFY1
NP_003698.1	ruvB-like 1	RUVBL1
NP_006657.1	ruvB-like 2	RUVBL2
NP_001026.2	ryanodine receptor 2	RYR2
NP_060549.4	S1 RNA-binding domain-containing protein 1	SRBD1
NP_055178.3	sacsin	SACS
NP_005902.1	S-adenosylmethionine synthase isoform type-2	MAT2A
NP_001121364.1	sal-like protein 1 isoform b	SALL1
NP_149073.1	SAP domain-containing ribonucleoprotein	SARNP
NP_001672.1	sarcoplasmic/endoplasmic reticulum calcium ATPase 2 isoform a	ATP2A2
NP_001188269.1	scaffold attachment factor B1 isoform 4	SAFB
NP_054745.1	scavenger mRNA-decapping enzyme DcpS	DCPS
NP_653283.3	schlafen family member 13	SLFN13
NP_060458.3	SCY1-like protein 2	SCYL2
NP_878255.1	sec1 family domain-containing protein 1 isoform b	SCFD1
NP_009121.1	SEC23-interacting protein	SEC23IP
NP_055581.3	secernin-1 isoform a	SCRN1
NP_001180457.1	secernin-3 isoform 2	SCRN3
NP_443069.1	secretory carrier-associated membrane protein 3 isoform 2	SCAMP3
NP_037408.2	sedoheptulokinase	SHPK
NP_004413.1	segment polarity protein dishevelled homolog DVL-2	DVL2
NP_004414.3	segment polarity protein dishevelled homolog DVL-3	DVL3
NP_001182533.1	selenide, water dikinase 1 isoform 3	SEPHS1
NP_113642.1	selenoprotein O	SELO
NP_057359.2	selenoprotein T precursor	SELT
NP_060713.1	septin-11	SEPT11
NP_004395.1	septin-2	SEPT2
NP_536340.1	septin-4 isoform 2	SEPT4
NP_002679.2	septin-5 isoform 1	SEPT5
NP_665798.1	septin-6 isoform A	SEPT6
NP_001011553.2	septin-7 isoform 2	SEPT7
NP_001092283.1	septin-8 isoform d	SEPT8
NP_006631.2	septin-9 isoform c	SEPT9
NP_001159829.1	serine hydroxymethyltransferase, mitochondrial isoform 3	SHMT2
NP_006406.1	serine palmitoyltransferase 1 isoform a	SPTLC1
NP_659540.1	serine protease HTRA2, mitochondrial isoform 2	HTRA2
NP_068766.1	serine racemase	SRR
NP_005830.2	serine/arginine repetitive matrix protein 1	SRRM1
NP_057417.3	serine/arginine repetitive matrix protein 2	SRRM2
NP_008855.1	serine/arginine-rich splicing factor 1 isoform 1	SRSF1
NP_003007.2	serine/arginine-rich splicing factor 2	SRSF2
NP_003008.1	serine/arginine-rich splicing factor 3	SRSF3
NP_006266.2	serine/arginine-rich splicing factor 6	SRSF6

Table 1 continued..

NP_001182375.1	serine/arginine-rich splicing factor 7 isoform 2	SRSF7
NP_003760.1	serine/arginine-rich splicing factor 9	SRSF9
NP_001645.1	serine/threonine-protein kinase A-Raf	ARAF
NP_001035350.2	serine/threonine-protein kinase DCLK2 isoform a	DCLK2
NP_004681.1	serine/threonine-protein kinase LATS1	LATS1
NP_055641.3	serine/threonine-protein kinase MRCK alpha isoform A	CDC42BPA
NP_004949.1	serine/threonine-protein kinase mTOR	MTOR
NP_005100.1	serine/threonine-protein kinase OSR1	OXSRI
NP_002568.2	serine/threonine-protein kinase PAK 2	PAK2
NP_872633.1	serine/threonine-protein kinase SRPK2 isoform b	SRPK2
NP_055638.2	serine/threonine-protein kinase WNK1 isoform 2	WNK1
NP_002705.2	serine/threonine-protein phosphatase 1 regulatory subunit 10	PPP1R10
NP_002708.1	serine/threonine-protein phosphatase 2A 55 kDa regulatory subunit B alpha isoform isoform 1	PPP2R2A
NP_851308.1	serine/threonine-protein phosphatase 2A 56 kDa regulatory subunit delta isoform isoform 3	PPP2R5D
NP_006237.1	serine/threonine-protein phosphatase 2A 56 kDa regulatory subunit epsilon isoform	PPP2R5E
NP_055040.2	serine/threonine-protein phosphatase 2A 65 kDa regulatory subunit A alpha isoform	PPP2R1A
NP_001180326.1	serine/threonine-protein phosphatase 2A activator isoform e	PPP2R4
NP_002706.1	serine/threonine-protein phosphatase 2A catalytic subunit alpha isoform	PPP2CA
NP_001230904.1	serine/threonine-protein phosphatase 2B catalytic subunit gamma isoform isoform 3	PPP3CC
NP_005125.1	serine/threonine-protein phosphatase 4 regulatory subunit 1 isoform b	PPP4R1
NP_115949.3	serine/threonine-protein phosphatase 4 regulatory subunit 3A	SMEK1
NP_001116841.1	serine/threonine-protein phosphatase 6 catalytic subunit isoform c	PPP6C
NP_001157636.1	serine/threonine-protein phosphatase 6 regulatory subunit 3 isoform 3	PPP6R3
NP_002700.1	serine/threonine-protein phosphatase PP1-beta catalytic subunit isoform 1	PPP1CB
NP_002701.1	serine/threonine-protein phosphatase PP1-gamma catalytic subunit	PPP1CC
NP_000042.3	serine-protein kinase ATM	ATM
NP_009109.3	serine-threonine kinase receptor-associated protein	STRAP
NP_001054.1	serotransferrin precursor	TF
NP_001226.2	serpin H1 precursor	SERPINH1
NP_001122326.1	serrate RNA effector molecule homolog isoform e	SRRT
NP_000468.1	serum albumin preproprotein	ALB
NP_001018171.1	serum paraoxonase/arylesterase 2 isoform 2	PON2
NP_006504.2	seryl-tRNA synthetase, cytoplasmic	SARS
NP_001975.1	S-formylglutathione hydrolase	ESD
NP_003013.1	SH3 domain-binding glutamic acid-rich-like protein	SH3BGRL
NP_112576.1	SH3 domain-binding glutamic acid-rich-like protein 3	SH3BGRL3
NP_055336.1	SH3 domain-binding protein 4	SH3BP4
NP_001171889.1	SH3 domain-containing kinase-binding protein 1 isoform c	SH3KBP1
NP_001189788.1	SHC-transforming protein 1 isoform 5 precursor	SHC1
NP_001120683.1	shootin-1 isoform a	KIAA1598
NP_001147107.1	short coiled-coil protein isoform 5	SCOC
NP_000008.1	short-chain specific acyl-CoA dehydrogenase, mitochondrial precursor	ACADS
NP_061819.2	sialic acid synthase	NANS
NP_055115.1	signal peptidase complex catalytic subunit SEC11A	SEC11A
NP_055567.2	signal peptidase complex subunit 2	SPCS2
NP_068747.1	signal peptidase complex subunit 3	SPCS3
NP_003125.3	signal recognition particle 14 kDa protein	SRP14
NP_001139754.1	signal recognition particle 54 kDa protein isoform 2	SRP54
NP_055045.2	signal recognition particle 68 kDa protein	SRP68
NP_008878.3	signal recognition particle 72 kDa protein	SRP72
NP_003124.1	signal recognition particle 9 kDa protein isoform 2	SRP9
NP_001171313.1	signal recognition particle receptor subunit alpha isoform 2	SRPR
NP_067026.3	signal recognition particle receptor subunit beta	SRPRB
NP_009330.1	signal transducer and activator of transcription 1-alpha/beta isoform alpha	STAT1
NP_938146.1	signal transducer and activator of transcription 2 isoform 2	STAT2

Table 1 continued..

NP_998827.1	signal transducer and activator of transcription 3 isoform 3	STAT3
NP_036580.2	signal transducer and activator of transcription 5B	STAT5B
NP_003134.1	single-stranded DNA-binding protein, mitochondrial precursor	SSBP1
NP_001093870.1	sister chromatid cohesion protein PDS5 homolog A isoform 3	PDS5A
NP_006387.1	Sjogren syndrome/scleroderma autoantigen 1	SSSCA1
NP_003052.2	slit homolog 1 protein precursor	SLIT1
NP_001036223.1	SLIT-ROBO Rho GTPase-activating protein 2 isoform b	SRGAP2
NP_001028289.1	SLIT-ROBO Rho GTPase-activating protein 3 isoform b	SRGAP3
NP_055082.1	small acidic protein	C11orf58
NP_003012.1	small glutamine-rich tetratricopeptide repeat-containing protein alpha	SGTA
NP_003085.1	small nuclear ribonucleoprotein E	SNRPE
NP_003086.1	small nuclear ribonucleoprotein F	SNRPF
NP_003087.1	small nuclear ribonucleoprotein G	SNRPG
NP_008869.1	small nuclear ribonucleoprotein Sm D1	SNRPD1
NP_808210.2	small nuclear ribonucleoprotein Sm D2 isoform 2	SNRPD2
NP_004166.1	small nuclear ribonucleoprotein Sm D3	SNRPD3
NP_003082.1	small nuclear ribonucleoprotein-associated proteins B and B' isoform B	SNRPB
NP_001005849.1	small ubiquitin-related modifier 2 isoform b precursor	SUMO2
NP_001153706.1	sodium/potassium-transporting ATPase subunit alpha-1 isoform d	ATP1A1
NP_001670.1	sodium/potassium-transporting ATPase subunit beta-3	ATP1B3
NP_001037.1	solute carrier family 12 member 2	SLC12A2
NP_001137310.1	solute carrier family 13 member 5 isoform b	SLC13A5
NP_006507.2	solute carrier family 2, facilitated glucose transporter member 1	SLC2A1
NP_001025029.2	solute carrier family 35 member F1	SLC35F1
NP_003095.2	sorbitol dehydrogenase	SORD
NP_944490.1	sorcin isoform b	SRI
NP_001192157.1	sortilin isoform 2	SORT1
NP_683758.1	sorting nexin-1 isoform b	SNX1
NP_037478.2	sorting nexin-12	SNX12
NP_003091.2	sorting nexin-2	SNX2
NP_112180.4	sorting nexin-27	SNX27
NP_055241.1	sorting nexin-5	SNX5
NP_057308.1	sorting nexin-9	SNX9
NP_003109.1	SPARC precursor	SPARC
NP_071420.1	SPARC-related modular calcium-binding protein 1 isoform 2 precursor	SMOC1
NP_001135766.1	spartin	SPG20
NP_001182461.1	spectrin alpha chain, brain isoform 3	SPTAN1
NP_003119.2	spectrin beta chain, brain 1 isoform 1	SPTBN1
NP_008877.1	spectrin beta chain, brain 2	SPTBN2
NP_663633.1	sperm equatorial segment protein 1 precursor	SPESP1
NP_003123.2	spermidine synthase	SRM
NP_004586.2	spermine synthase	SMS
NP_733779.1	S-phase kinase-associated protein 1 isoform b	SKP1
NP_004631.1	spliceosome RNA helicase DDX39B	DDX39B
NP_973727.1	splicing factor 1 isoform 3	SF1
NP_005868.1	splicing factor 3A subunit 1 isoform 1	SF3A1
NP_009096.2	splicing factor 3A subunit 2	SF3A2
NP_036565.2	splicing factor 3B subunit 1 isoform 1	SF3B1
NP_006833.2	splicing factor 3B subunit 2	SF3B2
NP_036558.3	splicing factor 3B subunit 3	SF3B3
NP_005841.1	splicing factor 3B subunit 4	SF3B4
NP_112577.1	splicing factor 3B subunit 5	SF3B5
NP_006749.1	splicing factor U2AF 35 kDa subunit isoform a	U2AF1
NP_001012496.1	splicing factor U2AF 65 kDa subunit isoform b	U2AF2
NP_001138917.1	splicing factor, arginine/serine-rich 15 isoform 3	SCAF4

Table 1 continued..

NP_005057.1	splicing factor, proline- and glutamine-rich	SFPQ
NP_004453.3	squalene synthase	FDFT1
NP_612632.1	src substrate cortactin isoform b	CTTN
NP_055205.2	staphylococcal nuclease domain-containing protein 1	SND1
NP_005554.1	stathmin isoform a	STMN1
NP_079182.2	stearoyl-CoA desaturase 5 isoform b	SCD5
NP_055892.2	sterile alpha and TIR motif-containing protein 1	SARM1
NP_001123237.1	sterol-4-alpha-carboxylate 3-dehydrogenase, decarboxylating	NSDHL
NP_038470.1	stomatin-like protein 2	STOML2
NP_004125.3	stress-70 protein, mitochondrial precursor	HSPA9
NP_006810.1	stress-induced-phosphoprotein 1	STIP1
NP_056110.2	structural maintenance of chromosomes flexible hinge domain-containing protein 1	SMCHD1
NP_006297.2	structural maintenance of chromosomes protein 1A	SMC1A
NP_005436.1	structural maintenance of chromosomes protein 3	SMC3
NP_005487.3	structural maintenance of chromosomes protein 4	SMC4
NP_004159.2	succinate dehydrogenase [ubiquinone] flavoprotein subunit, mitochondrial precursor	SDHA
NP_003840.2	succinyl-CoA ligase [GDP-forming] subunit alpha, mitochondrial precursor	SUCLG1
NP_001035935.2	sulfatase-modifying factor 2 isoform d precursor	SUMF2
NP_005491.1	SUMO-activating enzyme subunit 1 isoform a	SAE1
NP_005490.1	SUMO-activating enzyme subunit 2	UBA2
NP_003336.1	SUMO-conjugating enzyme UBC9	UBE2I
NP_056189.1	SUN domain-containing protein 2 isoform b	SUN2
NP_056175.3	superkiller viralicidic activity 2-like 2	SKIV2L2
NP_000445.1	superoxide dismutase [Cu-Zn]	SOD1
NP_006695.1	suppressor of G2 allele of SKP1 homolog isoform SGT1A	SUGT1
NP_149351.1	surfeit locus protein 4	SURF4
NP_055699.2	SURP and G-patch domain-containing protein 2	SUGP2
NP_003065.3	SWI/SNF complex subunit SMARCC1	SMARCC1
NP_620706.1	SWI/SNF complex subunit SMARCC2 isoform b	SMARCC2
NP_620710.2	SWI/SNF-related matrix-associated actin-dependent regulator of chromatin subfamily D member 1 isoform b	SMARCD1
NP_003070.3	SWI/SNF-related matrix-associated actin-dependent regulator of chromatin subfamily E member 1	SMARCE1
NP_055870.2	switch-associated protein 70	SWAP70
NP_004810.2	symplesin	SYMPK
NP_116185.2	synapse-associated protein 1	SYAP1
NP_055664.3	synaptic vesicle glycoprotein 2A	SV2A
NP_006364.2	synaptic vesicle membrane protein VAT-1 homolog	VAT1
NP_006546.1	synaptobrevin homolog YKT6	YKT6
NP_004773.1	synaptosomal-associated protein 29	SNAP29
NP_689493.3	synaptotagmin-11	SYT11
NP_068751.4	synembryn-A	RIC8A
NP_056101.5	synemin isoform B	SYNM
NP_005810.1	syntaxin-6	STX6
NP_001027392.1	syntaxin-binding protein 1 isoform b	STXBP1
NP_001007069.1	syntenin-1 isoform 2	SDCBP
NP_006280.3	talin-1	TLN1
NP_055874.2	talin-2	TLN2
NP_031401.1	TAR DNA-binding protein 43	TARDBP
NP_001129202.1	target of Myb protein 1 isoform 4	TOM1
NP_003963.1	TATA-binding protein-associated factor 172	BTAFL1
NP_055559.1	TBC1 domain family member 5 isoform b	TBC1D5
NP_055858.2	TBC1 domain family member 9B isoform b	TBC1D9B
NP_110379.2	T-complex protein 1 subunit alpha isoform a	TCP1
NP_001185771.1	T-complex protein 1 subunit beta isoform 2	CCT2
NP_006421.2	T-complex protein 1 subunit delta	CCT4

Table 1 continued..

NP_036205.1	T-complex protein 1 subunit epsilon	CCT5
NP_006420.1	T-complex protein 1 subunit eta isoform a	CCT7
NP_005989.3	T-complex protein 1 subunit gamma isoform a	CCT3
NP_006576.2	T-complex protein 1 subunit theta	CCT8
NP_001753.1	T-complex protein 1 subunit zeta isoform a	CCT6A
NP_055472.1	TEL2-interacting protein 1 homolog	TTI1
NP_057195.2	telomere length regulation protein TEL2 homolog	TELO2
NP_001171134.1	telomere-associated protein RIF1 isoform 2	RIF1
NP_002151.2	tenascin precursor	TNC
NP_001155056.1	testis-expressed sequence 10 protein isoform 2	TEX10
NP_076988.1	tether containing UBX domain for GLUT4	ASPCR1
NP_001138890.1	tetratricopeptide repeat protein 28	TTC28
NP_003240.1	thimet oligopeptidase	THOP1
NP_003320.2	thioredoxin	TXN
NP_116120.1	thioredoxin domain-containing protein 17	TXNDC17
NP_001139021.1	thioredoxin domain-containing protein 5 isoform 3	TXNDC5
NP_877419.1	thioredoxin reductase 1, cytoplasmic isoform 2	TXNRD1
NP_054817.2	thioredoxin-dependent peroxide reductase, mitochondrial isoform b	PRDX3
NP_004777.1	thioredoxin-like protein 1	TXNL1
NP_110382.3	thioredoxin-related transmembrane protein 1 precursor	TMX1
NP_001075019.1	THO complex subunit 2	THOC2
NP_005773.3	THO complex subunit 4	THOC4
NP_001002878.1	THO complex subunit 5 homolog	THOC5
NP_001135822.1	THO complex subunit 6 homolog isoform 2	THOC6
NP_689508.3	threonyl-tRNA synthetase, cytoplasmic	TARS
NP_006279.2	thy-1 membrane glycoprotein preproprotein	THY1
NP_001158503.1	thymidylate kinase isoform 2	DTYMK
NP_001027455.1	thymopoietin isoform gamma	TMPO
NP_066926.1	thymosin beta-10	TMSB10
NP_068832.1	thymosin beta-15A	TMSB15A
NP_066932.1	thymosin beta-4	TMSB4X
NP_005110.2	thyroid hormone receptor-associated protein 3	THRAP3
NP_783297.2	tight junction protein ZO-1 isoform b	TJP1
NP_690866.1	TIP41-like protein isoform 1	TIPRL
NP_061882.2	toll-interacting protein	TOLLIP
NP_055646.2	TPR and ankyrin repeat-containing protein 1	TRANK1
NP_001157941.1	TRAM adaptor with GOLD domain isoform 2	TMED7-TICAM2
NP_612510.1	trans-2,3-enoyl-CoA reductase	TECR
NP_006746.1	transaldolase	TALDO1
NP_001122320.1	transcription activator BRG1 isoform F	SMARCA4
NP_006747.1	transcription elongation factor A protein 1 isoform 1	TCEA1
NP_005639.1	transcription elongation factor B polypeptide 1 isoform a	TCEB1
NP_001124297.1	transcription elongation factor SPT5 isoform b	SUPT5H
NP_996923.1	transcription factor 12 isoform c	TCF12
NP_055787.1	transcription factor 25	TCF25
NP_001129969.1	transcription factor BTF3 homolog 4 isoform 2	BTF3L4
NP_001032726.1	transcription factor BTF3 isoform A	BTF3
NP_001230914.1	transcription factor p65 isoform 4	RELA
NP_060889.1	transcription factor SOX-18	SOX18
NP_003097.1	transcription factor SOX-2	SOX2
NP_003098.1	transcription factor SOX-4	SOX4
NP_006275.1	transcription initiation factor TFIID subunit 10	TAF10
NP_005753.1	transcription intermediary factor 1-beta	TRIM28
NP_005850.1	transcriptional activator protein Pur-alpha	PURA
NP_150093.1	transcriptional activator protein Pur-beta	PURB

Table 1 continued..

NP_065750.1	transcriptional repressor p66-beta	GATAD2B
NP_003225.2	transferrin receptor protein 1	TFRC
NP_003487.1	transformation/transcription domain-associated protein	TRRAP
NP_037425.1	transformer-2 protein homolog alpha	TRA2A
NP_001230808.1	transformer-2 protein homolog beta isoform 2	TRA2B
NP_001035919.1	transforming growth factor beta-1-induced transcript 1 protein isoform 1	TGFB1I1
NP_001655.1	transforming protein RhoA precursor	RHOA
NP_003555.1	transgelin-2	TAGLN2
NP_001008273.1	transgelin-3	TAGLN3
NP_009057.1	transitional endoplasmic reticulum ATPase	VCP
NP_001055.1	transketolase	TKT
NP_001405.1	translation initiation factor eIF-2B subunit alpha	EIF2B1
NP_055054.1	translation initiation factor eIF-2B subunit beta	EIF2B2
NP_001160060.1	translation initiation factor eIF-2B subunit gamma isoform 2	EIF2B3
NP_006827.1	translational activator GCN1	GCN1L1
NP_003286.1	translationally-controlled tumor protein	TPT1
NP_004613.1	translin	TSN
NP_005990.1	translin-associated protein X	TSNAX
NP_003135.2	translocon-associated protein subunit alpha precursor	SSR1
NP_006271.1	translocon-associated protein subunit delta isoform 2 precursor	SSR4
NP_009038.1	translocon-associated protein subunit gamma	SSR3
NP_004791.1	transmembrane 9 superfamily member 2 precursor	TM9SF2
NP_064508.3	transmembrane 9 superfamily member 3 precursor	TM9SF3
NP_061899.1	transmembrane and coiled-coil domain-containing protein 1	TMCO1
NP_006806.1	transmembrane emp24 domain-containing protein 2 precursor	TMED2
NP_059980.2	transmembrane emp24 domain-containing protein 9 precursor	TMED9
NP_001158502.1	transmembrane protein 41B isoform 2	TMEM41B
NP_077310.1	transmembrane protein 43	TMEM43
NP_055388.2	transmembrane protein 97	TMEM97
NP_219500.1	transmembrane protein C9orf123	C9orf123
NP_694858.1	transportin-1 isoform 2	TNPO1
NP_038461.2	transportin-2 isoform 2	TNPO2
NP_036602.1	transportin-3 isoform 1	TNPO3
NP_000347.2	treacle protein isoform b	TCOF1
NP_000173.2	trifunctional enzyme subunit alpha, mitochondrial precursor	HADHA
NP_000174.1	trifunctional enzyme subunit beta, mitochondrial precursor	HADHB
NP_001129477.1	trifunctional purine biosynthetic protein adenosine-3 isoform 1	GART
NP_000356.1	triosephosphate isomerase isoform 1	TPI1
NP_001123539.1	tripartite motif-containing protein 2 isoform 2	TRIM2
NP_150594.2	tripartite motif-containing protein 3	TRIM3
NP_149082.1	tripartite motif-containing protein 4 isoform beta	TRIM4
NP_258411.2	tripartite motif-containing protein 47	TRIM47
NP_000382.3	tripeptidyl-peptidase 1 preproprotein	TPP1
NP_003282.2	tripeptidyl-peptidase 2	TPP2
NP_009049.2	triple functional domain protein	TRIO
NP_001180384.1	tRNA (cytosine(34)-C(5))-methyltransferase isoform 2	NSUN2
NP_057488.1	tRNA methyltransferase 112 homolog	TRMT112
NP_055121.1	tRNA-splicing ligase RtcB homolog	C22orf28
NP_001136357.1	tropomodulin-2 isoform b	TMOD2
NP_055362.1	tropomodulin-3	TMOD3
NP_001036816.1	tropomyosin alpha-3 chain isoform 4	TPM3
NP_003281.1	tropomyosin alpha-4 chain isoform 2	TPM4
NP_004175.2	tryptophanyl-tRNA synthetase, cytoplasmic isoform a	WARS
NP_001230726.1	TSC22 domain family protein 1 isoform 3	TSC22D1
NP_001165335.1	tubulin alpha chain-like 3 isoform 2	TUBAL3

Table 1 continued..

NP_006000.2	tubulin alpha-1A chain	TUBA1A
NP_006073.2	tubulin alpha-1B chain	TUBA1B
NP_821133.1	tubulin beta chain	TUBB
NP_001060.1	tubulin beta-2A chain	TUBB2A
NP_821080.1	tubulin beta-2B chain	TUBB2B
NP_006079.1	tubulin beta-2C chain	TUBB2C
NP_006077.2	tubulin beta-3 chain isoform 1	TUBB3
NP_006078.2	tubulin beta-4 chain	TUBB4
NP_115914.1	tubulin beta-6 chain	TUBB6
NP_001061.2	tubulin gamma-1 chain	TUBG1
NP_001272.2	tubulin-folding cofactor B	TBCB
NP_004598.1	tubulin-specific chaperone A	TBCA
NP_005984.3	tubulin-specific chaperone D	TBCD
NP_003184.1	tubulin-specific chaperone E	TBCE
NP_055955.1	tubulin--tyrosine ligase-like protein 12	TLL12
NP_036275.1	tuftelin-interacting protein 11	TFIP11
NP_005070.1	tumor protein D52 isoform 3	TPD52
NP_955391.1	tumor protein D54 isoform f	TPD52L2
NP_005648.1	tumor suppressor p53-binding protein 1 isoform 3	TP53BP1
NP_006283.1	tumor susceptibility gene 101 protein	TSG101
NP_002813.3	twinfilin-1 isoform 2	TWF1
NP_009215.1	twinfilin-2	TWF2
NP_005424.1	tyrosine-protein kinase Yes	YES1
NP_002825.3	tyrosine-protein phosphatase non-receptor type 11	PTPN11
NP_001124481.1	tyrosine-protein phosphatase non-receptor type 12 isoform 3	PTPN12
NP_003671.1	tyrosyl-tRNA synthetase, cytoplasmic	YARS
NP_003080.2	U1 small nuclear ribonucleoprotein 70 kDa	SNRNP70
NP_004587.1	U1 small nuclear ribonucleoprotein A	SNRPA
NP_003084.1	U1 small nuclear ribonucleoprotein C	SNRPC
NP_003081.2	U2 small nuclear ribonucleoprotein A'	SNRPA1
NP_004695.1	U3 small nucleolar RNA-interacting protein 2	RRP9
NP_056444.3	U4/U6 small nuclear ribonucleoprotein Prp31	PRPF31
NP_004688.2	U4/U6 small nuclear ribonucleoprotein Prp4	PRPF4
NP_005137.1	U4/U6.U5 tri-snRNP-associated protein 1	SART1
NP_006581.2	U4/U6.U5 tri-snRNP-associated protein 2	USP39
NP_054733.2	U5 small nuclear ribonucleoprotein 200 kDa helicase	SNRNP200
NP_004805.2	U5 small nuclear ribonucleoprotein 40 kDa protein	SNRNP40
NP_055277.1	U6 snRNA-associated Sm-like protein LSM1	LSM1
NP_067000.1	U6 snRNA-associated Sm-like protein LSM2	LSM2
NP_055278.1	U6 snRNA-associated Sm-like protein LSM3	LSM3
NP_036454.1	U6 snRNA-associated Sm-like protein LSM5 isoform a	LSM5
NP_057283.1	U6 snRNA-associated Sm-like protein LSM7	LSM7
NP_038466.2	ubiquilin-1 isoform 1	UBQLN1
NP_038472.2	ubiquilin-2	UBQLN2
NP_064516.2	ubiquilin-4	UBQLN4
NP_004642.2	ubiquitin carboxyl-terminal hydrolase 11	USP11
NP_003931.2	ubiquitin carboxyl-terminal hydrolase 13	USP13
NP_001032411.1	ubiquitin carboxyl-terminal hydrolase 14 isoform b	USP14
NP_056121.2	ubiquitin carboxyl-terminal hydrolase 24	USP24
NP_003472.2	ubiquitin carboxyl-terminal hydrolase 5 isoform 2	USP5
NP_003461.2	ubiquitin carboxyl-terminal hydrolase 7	USP7
NP_004172.2	ubiquitin carboxyl-terminal hydrolase isozyme L1	UCHL1
NP_001186192.1	ubiquitin carboxyl-terminal hydrolase isozyme L5 isoform 4	UCHL5
NP_001191006.1	ubiquitin conjugation factor E4 A isoform 2	UBE4A
NP_001030324.2	ubiquitin fusion degradation protein 1 homolog isoform B	UFD1L

Table 1 continued..

NP_060140.2	ubiquitin thioesterase OTUB1	OTUB1
NP_937826.1	ubiquitin/ISG15-conjugating enzyme E2 L6 isoform 2	UBE2L6
NP_001129064.1	ubiquitin-40S ribosomal protein S27a precursor	RPS27A
NP_116262.2	ubiquitin-associated and SH3 domain-containing protein B	UBASH3B
NP_001120792.1	ubiquitin-associated protein 2-like isoform b	UBAP2L
NP_862821.1	ubiquitin-conjugating enzyme E2 D2 isoform 2	UBE2D2
NP_001104582.1	ubiquitin-conjugating enzyme E2 K isoform 2	UBE2K
NP_003338.1	ubiquitin-conjugating enzyme E2 L3	UBE2L3
NP_003339.1	ubiquitin-conjugating enzyme E2 N	UBE2N
NP_060052.3	ubiquitin-conjugating enzyme E2 Q1	UBE2Q1
NP_001027459.1	ubiquitin-conjugating enzyme E2 variant 1 isoform d	UBE2V1
NP_003341.1	ubiquitin-conjugating enzyme E2 variant 2	UBE2V2
NP_695012.1	ubiquitin-like modifier-activating enzyme 1	UBA1
NP_079094.1	ubiquitin-like modifier-activating enzyme 5 isoform 1	UBA5
NP_060697.4	ubiquitin-like modifier-activating enzyme 6	UBA6
NP_001988.1	ubiquitin-like protein fubi and ribosomal protein S30 precursor	FAU
NP_112176.1	ubiquitin-related modifier 1 homolog isoform a	URM1
NP_056937.2	UBX domain-containing protein 1	UBXN1
NP_001070730.1	UBX domain-containing protein 11 isoform 3	UBXN11
NP_055422.1	UBX domain-containing protein 4	UBXN4
NP_056377.1	UBX domain-containing protein 7	UBXN7
NP_001171630.1	UDP-glucose 6-dehydrogenase isoform 3	UGDH
NP_064505.1	UDP-glucose:glycoprotein glucosyltransferase 1 precursor	UGGT1
NP_858059.1	UDP-N-acetylglucosamine--peptide N-acetylglucosaminyltransferase 110 kDa subunit isoform 2	OGT
NP_997192.2	UDP-N-acetylhexosamine pyrophosphorylase-like protein 1	UAP1L1
NP_057392.1	UMP-CMP kinase isoform a	CMPK1
NP_055592.2	unhealthy ribosome biogenesis protein 2 homolog	URB2
NP_001071132.1	up-regulated gene 4 isoform 2	URGCP
NP_000365.3	uroporphyrinogen decarboxylase	UROD
NP_006750.3	UTP--glucose-1-phosphate uridylyltransferase isoform a	UGP2
NP_005044.1	UV excision repair protein RAD23 homolog A	RAD23A
NP_002865.1	UV excision repair protein RAD23 homolog B	RAD23B
NP_068375.3	vacuolar protein sorting-associated protein 11 homolog	VPS11
NP_001030337.1	vacuolar protein sorting-associated protein 26A isoform 2	VPS26A
NP_057310.1	vacuolar protein sorting-associated protein 29 isoform 1	VPS29
NP_060676.2	vacuolar protein sorting-associated protein 35	VPS35
NP_009190.2	vacuolar protein sorting-associated protein 45	VPS45
NP_004860.2	vacuolar protein sorting-associated protein 4B	VPS4B
NP_006286.1	valyl-tRNA synthetase	VARS
NP_003361.1	vasodilator-stimulated phosphoprotein	VASP
NP_001119808.1	versican core protein isoform 2 precursor	VCAN
NP_057156.1	vesicle transport protein GOT1B	GOLT1B
NP_004772.1	vesicle-associated membrane protein 3	VAMP3
NP_919415.2	vesicle-associated membrane protein-associated protein A isoform 2	VAPA
NP_001182606.1	vesicle-associated membrane protein-associated protein B/C isoform 2	VAPB
NP_006169.2	vesicle-fusing ATPase	NSF
NP_004883.2	vesicle-trafficking protein SEC22b	SEC22B
NP_006807.1	vesicular integral-membrane protein VIP36 precursor	LMAN2
NP_001230829.1	vigilin isoform b	HDLBP
NP_003371.2	vimentin	VIM
NP_003364.1	vinculin isoform VCL	VCL
NP_000304.2	vitamin K-dependent protein S preproprotein	PROS1
NP_003365.1	voltage-dependent anion-selective channel protein 1	VDAC1
NP_001681.2	V-type proton ATPase catalytic subunit A	ATP6V1A
NP_001684.2	V-type proton ATPase subunit B, brain isoform	ATP6V1B2

Table 1 continued..

NP_001686.1	V-type proton ATPase subunit C 1	ATP6V1C1
NP_004682.2	V-type proton ATPase subunit d 1	ATP6V0D1
NP_001034455.1	V-type proton ATPase subunit E 1 isoform b	ATP6V1E1
NP_004222.2	V-type proton ATPase subunit F isoform 1	ATP6V1F
NP_004879.1	V-type proton ATPase subunit G 1	ATP6V1G1
NP_998784.1	V-type proton ATPase subunit H isoform 2	ATP6V1H
NP_055661.3	WASH complex subunit strumpellin	KIAA0196
NP_065881.1	WD repeat and FYVE domain-containing protein 1	WDFY1
NP_059830.1	WD repeat-containing protein 1 isoform 1	WDR1
NP_001108585.2	WD repeat-containing protein 26 isoform b	WDR26
NP_055946.1	WD repeat-containing protein 43	WDR43
NP_079510.1	WD repeat-containing protein 61	WDR61
NP_079498.2	WD repeat-containing protein 82	WDR82
NP_060695.2	WD40 repeat-containing protein SMU1	SMU1
NP_003922.1	wiskott-Aldrich syndrome protein family member 1	WASF1
NP_036610.2	WW domain-binding protein 2	WBP2
NP_065116.3	xaa-Pro aminopeptidase 1 isoform 1	XPNPEP1
NP_000276.2	xaa-Pro dipeptidase isoform 1	PEPD
NP_066964.1	X-ray repair cross-complementing protein 5	XRCC5
NP_001460.1	X-ray repair cross-complementing protein 6	XRCC6
NP_001177906.1	YY1-associated factor 2 isoform 3	YAF2
NP_001157785.1	zinc finger and BTB domain-containing protein 24 isoform 2	ZBTB24
NP_653205.3	zinc finger CCCH domain-containing protein 18	ZC3H18
NP_055983.1	zinc finger CCCH domain-containing protein 4	ZC3H4
NP_078901.3	zinc finger CCCH-type antiviral protein 1 isoform 2	ZC3HAV1
NP_003444.1	zinc finger MYM-type protein 2	ZMYM2
NP_001164633.1	zinc finger MYM-type protein 3 isoform 2	ZMYM3
NP_443089.3	zinc finger protein 830	ZNF830
NP_057191.2	zinc finger RNA-binding protein	ZFR
NP_659499.2	zinc finger with UFM1-specific peptidase domain protein	ZUFSP
NP_055928.3	zinc finger ZZ-type and EF-hand domain-containing protein 1	ZZEF1
NP_003452.1	zyxin	ZYX

PKM2 is reported to promote the Warburg effect, which is the observation that energy production depends on aerobic glycolysis in most cancer cells [29, 30], through interacting directly with hypoxia-inducible factor 1 α subunit and promoting transactivation of its target genes [21]. LASP-1 is located in the same chromosome 17 as ERBB2 and known to be overexpressed in some breast cancers. GSTP1 is recognized as an important player in detoxification pathways [28] and shows resistance to an anti-cancer drug called cisplatin [31].

Gene ontology analysis of the proteome in glioblastoma stem cells

Next, in order to systematically grasp the glioblastoma protein networks, gene ontology analysis was conducted in terms of biological process, molecular function and cellular component based on Human Protein Reference Database

(HPRD) (<http://www.hprd.org/>) [32] (Figure 1). Our analysis indicated that they were localized in various compartments such as cytoplasm, nucleus and plasma membrane (37%, 30% and 8%, respectively). The proteins associated with “signal transduction”, “regulation of nucleobase, nucleoside, nucleotide and nucleic acid metabolism”, “protein metabolism” and “metabolism/energy pathways” showed similar proportions (about 16%) in terms of biological processes. The classification by molecular function showed that the rates of factors that belong to RNA/DNA binding, transcription regulator/factor activity and transporter activity were 9%, 6% and 5% of all the identified proteins, respectively.

In terms of RNA binding, plasminogen activator inhibitor 1 (SERBP1/PAI-1), which is known to be activated by HIF-2 α and contribute to exhibit stem cell-like characteristics [33], was prominently

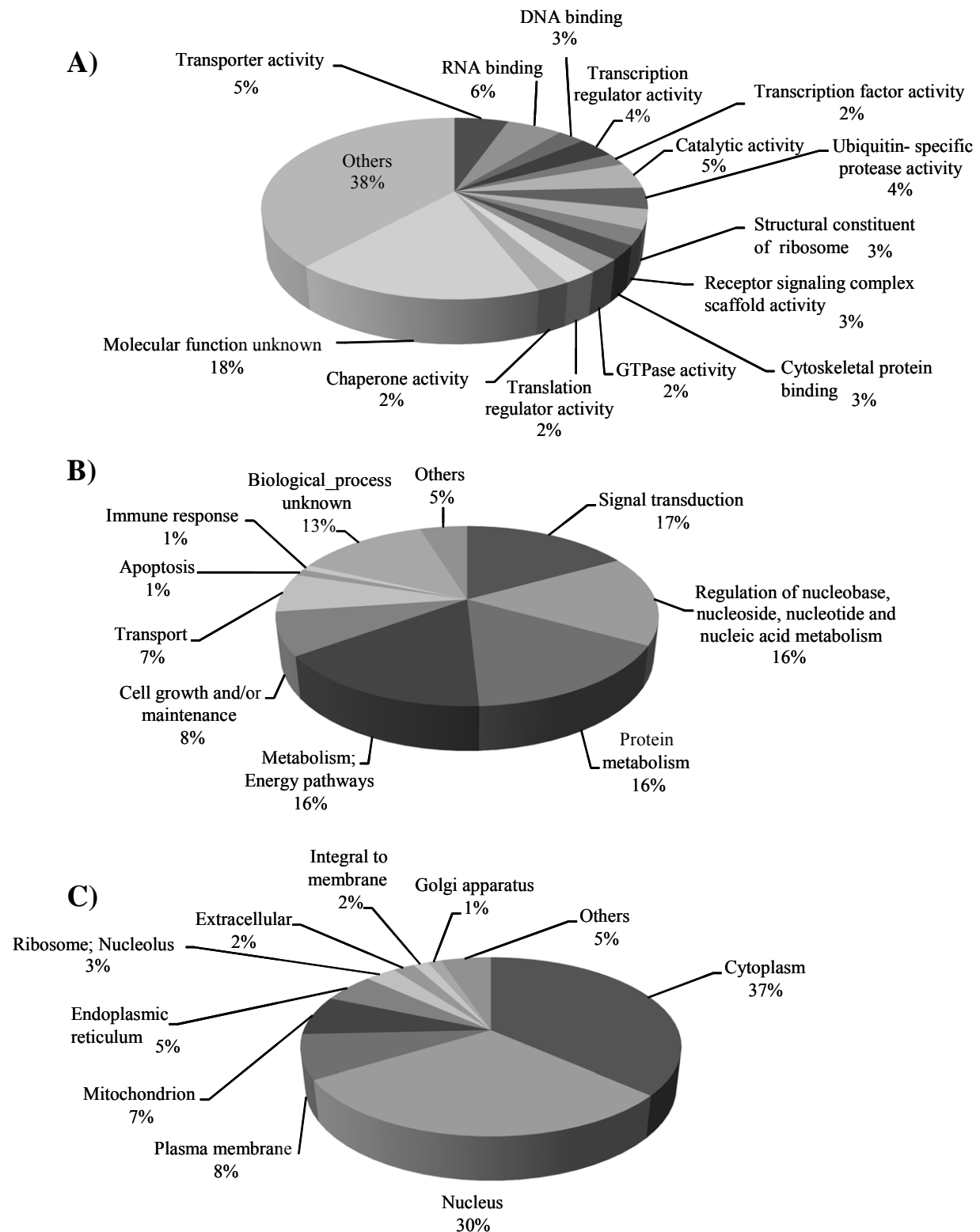


Figure 1. Functional classification of the glioblastoma proteome based on the Gene Ontology information in the Human Protein Reference Database (HPRD) (<http://www.hprd.org/>). The identified proteins are classified by (A) molecular function, (B) biological process and (C) cellular component, respectively.

identified in our proteomic analysis. The transcription-related molecules such as signal transducer and activator of transcription 3 (STAT3) and transforming growth factor beta-1 (TGFB1) were also detected. STAT3 is widely recognized as a key regulator in various types of stem cells [34]. Meanwhile, TGFB1 was reported to induce the expression of epithelial-mesenchymal transition (EMT) marker such as vimentin and fibroblast specific protein 1 (FSP1) [35]. Furthermore, TGFB1 can also play an important role in endothelial-mesenchymal transition (EndMT) in mouse embryonic stem cell-derived endothelial cells [36]. In terms of transporter activity, fatty acid-binding protein, brain (FABP7) was dominantly detected. This molecule was shown to be a direct target of Notch signaling in radial glial cells [37], which are recognized to function as neural stem cells in developing brains [38].

Thus, our in-depth proteomic analysis has revealed the existence of various functional molecules that are considered to contribute to the characteristics of glioblastoma stem cells.

Pathway analysis of the proteome in glioblastoma stem cells

In order to elucidate the glioblastoma networks in detail, we then performed pathway analysis using Database for Annotation, Visualization and Integrated Discovery (DAVID) software [39]. As a result, several pathways in diverse contexts were identified with $p < 0.0001$ by modified Fisher exact test (Table 2). Especially, glycolysis/gluconeogenesis, pyruvate metabolism and pentose phosphate pathway, which are related to cancer and cancer stem-like cells and involved in the Warburg effect, were enriched in the glioblastoma stem cells [40]. Interestingly, our analysis also uncovered a highly enriched fraction of the protein complexes related to ribosome, spliceosome and proteasome machineries ($p < 1 \times 10^{-15}$) (Figure 2). Although the recent large-scale proteomic analysis of human HeLa cells has revealed ribosomal and proteasomal proteins as highly abundant cellular components [41], our analysis of glioblastoma stem cells also revealed

Table 2. Pathway analysis of the proteins identified from glioblastoma stem cells using DAVID software.

Classification	Associated molecules	P-Value ^a	Ratio ^b
Ribosome	FAU RPL10 RPL10A RPL11 RPL12 RPL13 RPL13A RPL14 RPL15 RPL17 RPL18 RPL18A RPL19 RPL21 RPL22 RPL23 RPL23A RPL24 RPL26 RPL27 RPL27A RPL28 RPL29 RPL30 RPL31 RPL34 RPL35 RPL36 HNRNPH2 RPL3 RPL4 RPL5 RPL6 RPL7 RPL7A RPL8 RPL9 RPS11 RPS12 RPS13 RPS15 RPS15A RPS16 RPS18 RPS19 RPS2 RPS20 RPS21 RPS23 RPS24 RPS25 RPS26 RPS27 RPS27A RPS28 RPS29 RPS3 RPS3A RPS4X RPS5 RPS6 RPS7 RPS8 RPS9 RPSA RPLP0 RPLP1 RPLP2 RPL32	1.5E-35	69/87
Spliceosome	BUD31 DDX23 DDX42 DDX5 DHX15 LSM2 LSM3 LSM5 LSM7 NHP2L1 PRPF19 PRPF31 PRPF4 PRPF40A PRPF8 RBM25 RBM8A SLU7 THOC2 THOC4 U2AF1 U2AF2 ACIN1 AQR CTNBL1 EFTUD2 EIF4A3 HSPA1B HSPA8 HNRNPA1 HNRNPA3 HNRNPC HNRNPK HNRNPM HNRNPU SNRPG MAGOH NCBP1 PPIL1 PPIE PCBP1 PUF60 PRPF6 SNRNP200 SNRNP40 SNRNP70 SNRPD1 SNRPD2 SNRPD3 SNRPA SNRPA1 SNRPC SNRPE SNRPF SNRPB SF3A1 SF3A2 SF3B1 SF3B2 SF3B3 SF3B4 SF3B5 SART1 TRA2A TRA2B USP39	1.2E-18	66/126
Proteasome	PSMC1 PSMC2 PSMC3 PSMC5 PSMC6 PSMD1 PSMD11 PSMD12 PSMD13 PSMD14 PSMD2 PSMD3 PSMD4 PSMD6 PSMD7 PSMD8 PSME1 PSME2 PSME3 PSMA1 PSMA2 PSMA3 PSMA4 PSMA5 PSMA6 PSMA8 PSMB1 PSMB2 PSMB3 PSMB4 PSMB5 PSMB6 PSMB7 PSMB8 PSMC4	1.7E-16	35/47

Table 2 continued..

Aminoacyl-tRNA biosynthesis	AARS RARS NARS DARS CARS CARS2 QARS EPRS GARS HARS "DTD1, HARS2" IARS IARS2 LARS KARS MARS FARSA FARSB SARS TARS WARS YARS VARS	1.7E-7	23/41
Glycolysis / Gluconeogenesis	BPGM TPI1 ACSS2 ADH5 ALDH3A2 ALDH9A1 AKR1A1 ALDOA ALDOC DLAT DLD ENO1 ENO2 GPI GAPDH HK1 LDHA LDHB PFKL PFKM PFKP PGM1 PGM2 PGK1 PGK2 PGAM1 PDHA1 PDHB PKM2	1.8E-7	29/60
DNA replication	FEN1 MCM2 MCM3 MCM4 MCM5 MCM6 MCM7 POLA1 POLA2 POLD2 POLE2 PCNA RFC2 RFC3 RFC4 RFC5 RPA3 RNASEH2A SSBP1	8.6E-6	19/36
Pyruvate metabolism	ACAT1 ACAT2 ACACA ACSS2 ALDH3A2 ALDH9A1 AKR1B1 DLAT DLD GLO1 GRHPR HAGH LDHA LDHB MDH1 MDH2 ME2 PDHA1 PDHB PKM2	1.3E-5	20/40
Pentose phosphate pathway	DERA PGLS ALDOA ALDOC GPI G6PD PFKL PFKM PFKP PGM1 PGM2 PGD PRPS1 TALDO1 TKT	1.7E-5	15/25
Citrate cycle	ACLY ACO1 ACO2 CS DLAT DLD FH IDH1 IDH2 IDH3A MDH1 MDH2 PDHA1 PDHB SDHA SUCLG1	8.0E-5	16/31

^a The pathways highly enriched with $p < 0.0001$ (modified Fisher exact test) are listed.

^b "Ratio" represents the number of the identified molecules/that of all the molecules related to each category.

A)

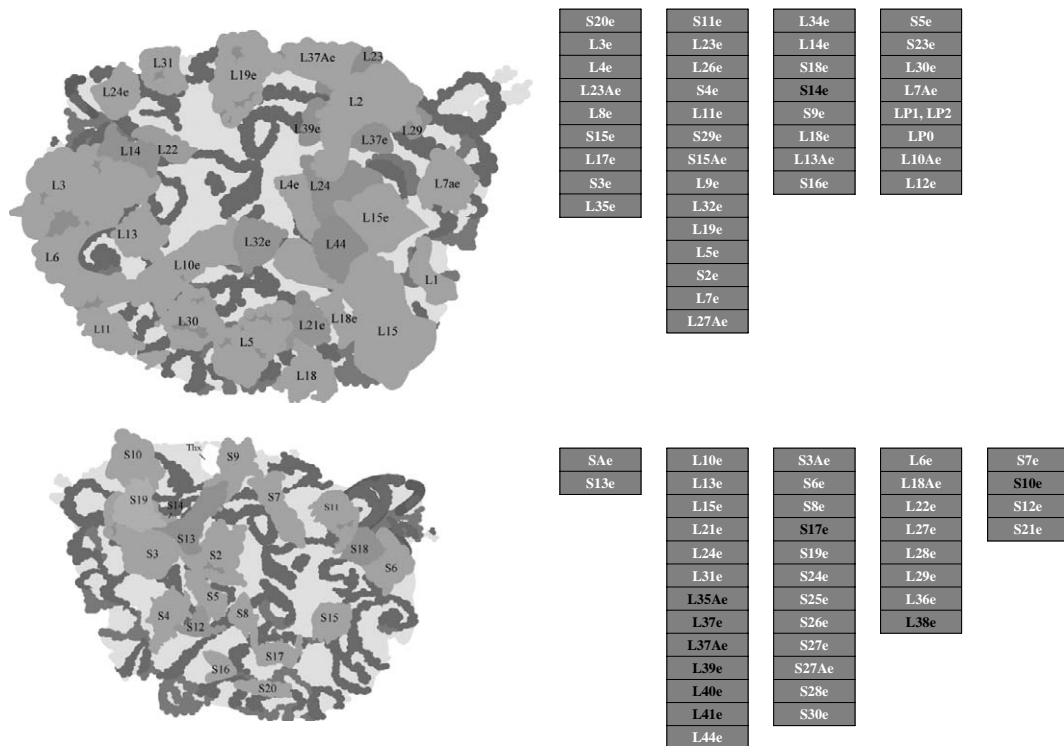
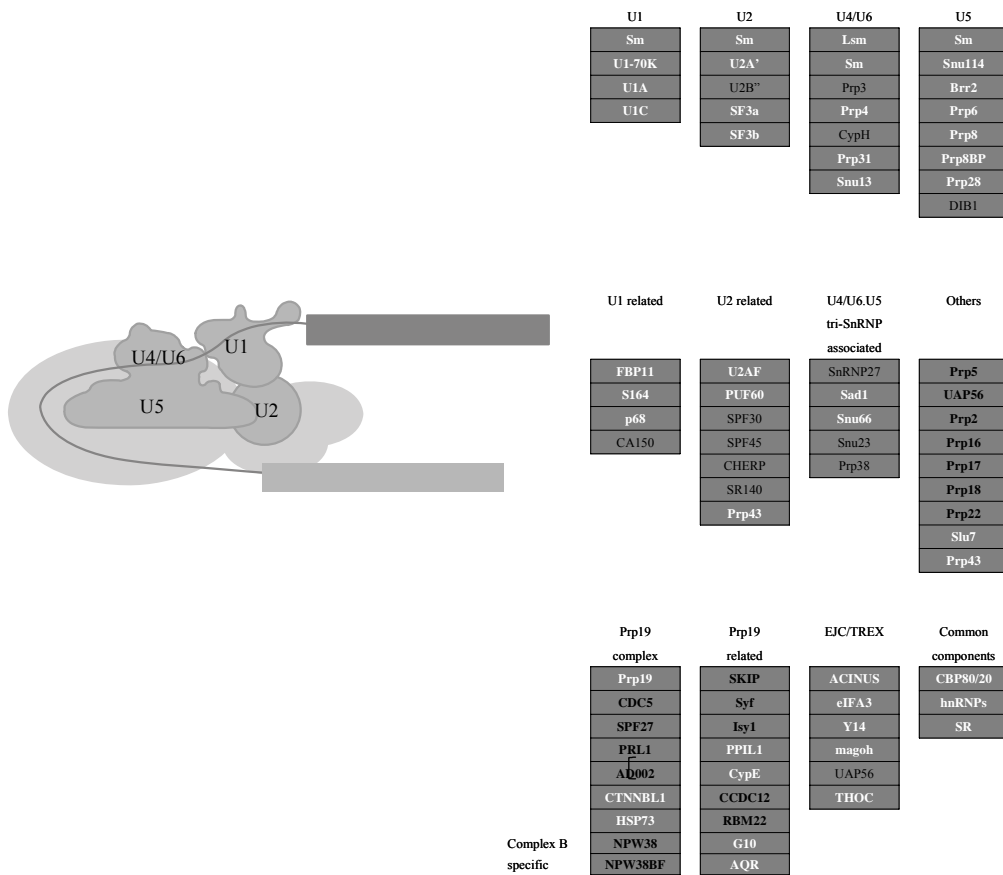


Figure 2

Figure 2 continued..

B)



C)

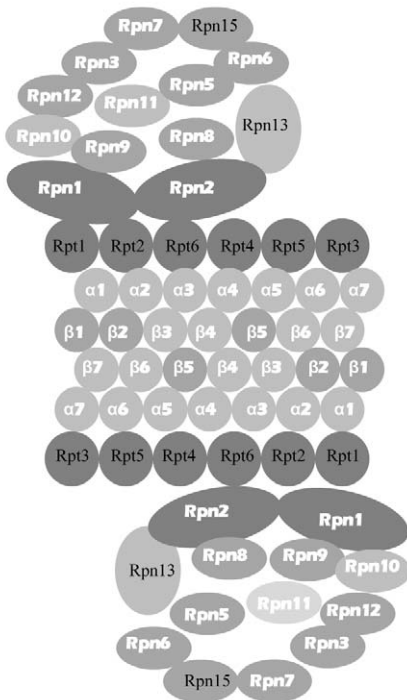


Figure 2. Schematic structures of (A) ribosome, (B) spliceosome and (C) proteasome. The identified molecules are indicated in white letters.

spliceosomal complexes, along with ribosome and proteasome, contributed to the glioblastoma proteome as one of the most abundant distributions.

CONCLUSION

Our in-depth proteomic analysis of glioblastoma stem cells provided a global view of their protein networks/pathways at the system level. As these stem cell populations are considered to be potential therapeutic targets [42-43], our data should provide fundamental information to understand the regulatory mechanism of this aggressive cancer. Mass spectrometry-based proteomics technology, along with FACS and gene expression analyses, will facilitate systematic characterization of key regulators for defining glioblastoma.

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