

Supplementary Table 1a

Category	Description	padj	Count
BP	outflow tract morphogenesis	7.02000327511685e-07	22
BP	angiogenesis	1.57379559536215e-06	69
BP	mesenchyme development	1.11446082691485e-05	41
BP	heart contraction	1.11446082691485e-05	41
BP	heart process	1.32975235706187e-05	41
BP	regulation of heart contraction	1.91205127326123e-05	37
BP	positive regulation of nervous system development	2.64190240762443e-05	64
BP	metanephros development	2.64190240762443e-05	21
BP	morphogenesis of a branching epithelium	2.64190240762443e-05	33
BP	appendage development	2.64190240762443e-05	32
BP	limb development	2.64190240762443e-05	32
BP	positive regulation of neurogenesis	2.91185516873246e-05	58
BP	regulation of blood circulation	2.91185516873246e-05	40
BP	taxis	2.97398233799114e-05	66
BP	neural crest cell migration	3.16528529947426e-05	15
BP	regulation of vasculature development	3.16528529947426e-05	46
BP	embryonic limb morphogenesis	4.09324951202949e-05	26
BP	embryonic appendage morphogenesis	4.09324951202949e-05	26
BP	chemotaxis	4.09324951202949e-05	65
BP	cardiac septum morphogenesis	4.09324951202949e-05	18
BP	appendage morphogenesis	4.09324951202949e-05	28
BP	limb morphogenesis	4.09324951202949e-05	28
BP	positive regulation of cell development	5.34350492499737e-05	62
BP	morphogenesis of a branching structure	5.57886442879361e-05	33
BP	cardiac conduction	9.2081891069589e-05	25

BP	heart morphogenesis	9.42973367958875e-05	36
BP	stem cell development	0.000109665380059306	18
BP	regulation of angiogenesis	0.000109665380059306	42
BP	response to purine-containing compound	0.00011163235292319	26
BP	response to cAMP	0.000120758214966012	20
BP	salivary gland morphogenesis	0.000120758214966012	12
	cardiac neural crest cell differentiation involved in heart		
BP	development	0.000120758214966012	7
	cardiac neural crest cell development involved in heart		
BP	development	0.000120758214966012	7
BP	epithelial tube morphogenesis	0.000122285469796018	44
BP	cardiac chamber morphogenesis	0.000143807586375223	23
BP	cardiac septum development	0.000143807586375223	21
BP	regulation of epithelial cell proliferation	0.000143807586375223	43

Supplementary Table 1b

Category	Description	padj	Count
CC	extracellular matrix component	2.54021571520067e-06	26
CC	extracellular matrix	3.21419950655339e-06	58
CC	proteinaceous extracellular matrix	3.22803344828017e-05	47
CC	basement membrane	0.000929560283749037	18
CC	plasma membrane protein complex	0.000929560283749037	60
CC	extrinsic component of plasma membrane	0.00200116856479673	26
CC	apicolateral plasma membrane	0.00400588920209196	7
CC	cation channel complex	0.00559619243576811	27
CC	axon	0.00559619243576811	57
CC	extrinsic component of membrane	0.00630982571306899	35
CC	side of membrane	0.00630982571306899	46
CC	ion channel complex	0.00728372841383739	32
CC	heterotrimeric G-protein complex	0.00728372841383739	9
CC	GTPase complex	0.00728372841383739	9
CC	complex of collagen trimers	0.00933563658317882	7
CC	catenin complex	0.00933563658317882	8
CC	transmembrane transporter complex	0.0141869944085309	33
CC	cell-cell junction	0.0141869944085309	45
CC	cell-cell adherens junction	0.0141869944085309	17
CC	collagen trimer	0.0141869944085309	14
CC	cytoplasmic side of plasma membrane	0.0188317141189162	23
CC	transporter complex	0.0195310529595606	33
CC	sarcolemma	0.0209952111785609	18
CC	sarcoplasm	0.0410225043369404	12
CC	cornified envelope	0.0410225043369404	6

Supplementary Table 1c

Category	Description	padj	Count
MF	voltage-gated cation channel activity	0.000213979223347845	25
MF	voltage-gated potassium channel activity	0.00273280976178477	17
MF	transcriptional activator activity, RNA polymerase II transcription regulatory region sequence-specific DNA binding	0.00651360075601879	47
MF	transcription factor activity, RNA polymerase II proximal promoter sequence-specific DNA binding	0.00651360075601879	47
MF	voltage-gated ion channel activity	0.00651360075601879	26
MF	voltage-gated channel activity	0.00651360075601879	26
MF	semaphorin receptor binding	0.0153135361611077	7
MF	potassium channel activity	0.0153899994963791	18
MF	transcriptional activator activity, RNA polymerase II proximal promoter sequence-specific DNA binding	0.0167027610779991	33
MF	cAMP binding	0.0178778040579876	7
MF	chemorepellent activity	0.0178778040579876	7
MF	proximal promoter sequence-specific DNA binding	0.0178778040579876	47
MF	RNA polymerase II proximal promoter sequence-specific DNA binding	0.0178778040579876	46
MF	ion gated channel activity	0.0195287453588265	34
MF	metal ion transmembrane transporter activity	0.0195287453588265	45
MF	potassium ion transmembrane transporter activity	0.0195287453588265	21
MF	gated channel activity	0.0207900155558087	34
MF	scaffold protein binding	0.0357953608581724	11
MF	cation channel activity	0.0373284728267236	32
MF	SMAD binding	0.0373721522764671	13
MF	cyclic nucleotide binding	0.0373721522764671	8
MF	neuropilin binding	0.0373721522764671	6
MF	extracellular matrix binding	0.0373721522764671	10
MF	receptor regulator activity	0.0373721522764671	38
MF	PDZ domain binding	0.0384062990481793	14
MF	ion channel activity	0.0384062990481793	39

Supplementary Table 2

Description	padj	Count
Cell adhesion molecules	2.0588927702883e-05	24
ECM-receptor interaction	8.88563683102987e-05	17
cAMP signaling pathway	0.000116100353652624	28
PI3K-Akt signaling pathway	0.000123953461127856	41
Cholinergic synapse	0.000809174667692485	17
Apelin signaling pathway	0.00105322770703402	21
MicroRNAs in cancer	0.00172818890538588	23
GABAergic synapse	0.00193685366237806	14
Breast cancer	0.00223351573797077	20
Rap1 signaling pathway	0.00272772782081884	27
Axon guidance	0.00428775099319498	23
Circadian entrainment	0.00428775099319498	14
Focal adhesion	0.00428775099319498	27
Relaxin signaling pathway	0.00526589556787713	17
Insulin resistance	0.00624452393869958	15
Melanoma	0.00724017926972894	12
MAPK signaling pathway	0.00749947620895896	32
Calcium signaling pathway	0.00749947620895896	25
Gastric cancer	0.010533923356219	18
Glutamatergic synapse	0.0113257442974558	14
FoxO signaling pathway	0.0147595856208177	18
Morphine addiction	0.0154989737151924	11
Cushing syndrome	0.0154989737151924	18
Protein digestion and absorption	0.015969932541887	12
Chemical carcinogenesis - receptor activation	0.016924254484112	21
Cocaine addiction	0.016924254484112	8
Arrhythmogenic right ventricular cardiomyopathy	0.016924254484112	14
Epstein-Barr virus infection	0.0170185835646838	23
Signaling pathways regulating pluripotency of stem cells	0.0170185835646838	17
Adrenergic signaling in cardiomyocytes	0.0170780685179727	16
Malaria	0.0170780685179727	7
Parathyroid hormone synthesis, secretion and action	0.0181454882651766	13
Non-small cell lung cancer	0.0192646854809344	11
AMPK signaling pathway	0.0210260548607046	15
Amphetamine addiction	0.0239008575032531	9
Human papillomavirus infection	0.0239008575032531	31
Th1 and Th2 cell differentiation	0.0250784741670213	11
Insulin secretion	0.0252114070352434	10
Type II diabetes mellitus	0.0255924047109963	8
AGE-RAGE signaling pathway in diabetic complications	0.025846661855128	12

Ras signaling pathway	0.0278326786534617	25
Wnt signaling pathway	0.0280770584607444	18
Osteoclast differentiation	0.0320908308796569	13
PPAR signaling pathway	0.0326266528270885	11
Maturity onset diabetes of the young	0.0330614390047983	4
TGF-beta signaling pathway	0.0416984731340275	12
Dopaminergic synapse	0.0416984731340275	13
Glioma	0.0491332395055089	10

Supplementary Table 3

Description	p.adjust	Count
Proteoglycans in cancer	7.5e-38	116
Lipid and atherosclerosis	1.15e-34	115
Hepatitis B	1.15e-34	97
AGE-RAGE signaling pathway in diabetic complications	1.45e-34	73
TNF signaling pathway	1.45e-32	76
MAPK signaling pathway	4.59e-32	135
Human cytomegalovirus infection	6.94e-32	114
PI3K-Akt signaling pathway	1.29e-31	151
Cellular senescence	8.86e-31	90
Prostate cancer	1.21e-29	67
Endocrine resistance	2.94e-29	67
Breast cancer	2.98e-29	85
Pancreatic cancer	2.22e-28	57
Chronic myeloid leukemia	2.22e-28	57
Human papillomavirus infection	3.43e-27	137
Colorectal cancer	5.28e-26	59
Gastric cancer	1.69e-25	81
Signaling pathways regulating pluripotency of stem cells	1.69e-25	79
Kaposi sarcoma-associated herpesvirus infection	2.3e-25	95
Human T-cell leukemia virus 1 infection	3.88e-25	103
EGFR tyrosine kinase inhibitor resistance	7.53e-25	55
FoxO signaling pathway	6.05e-24	73
Epstein-Barr virus infection	9.15e-24	95
MicroRNAs in cancer	1.1e-23	125
Focal adhesion	2.54e-23	94
Hepatocellular carcinoma	1.39e-22	83
Small cell lung cancer	5.98e-22	57
Renal cell carcinoma	8.75e-22	48
Yersinia infection	1.11e-21	72
Fluid shear stress and atherosclerosis	3.31e-21	72
Chagas disease	1.3e-20	59
HIF-1 signaling pathway	2.67e-20	61
Toxoplasmosis	2.67e-20	62
Bladder cancer	9.12e-20	34
Melanoma	1.26e-19	47
Human immunodeficiency virus 1 infection	1.62e-19	91
Prolactin signaling pathway	2.04e-19	46
Neurotrophin signaling pathway	2.55e-19	63
Hepatitis C	8.85e-19	74
Shigellosis	1.12e-18	99

Glioma	1.34e-18	47
IL-17 signaling pathway	5.63e-18	53
PD-L1 expression and PD-1 checkpoint pathway in cancer	9.7e-18	51
Measles	9.86e-18	67
C-type lectin receptor signaling pathway	9.86e-18	56
Acute myeloid leukemia	1.12e-17	43
Central carbon metabolism in cancer	1.44e-17	44
Osteoclast differentiation	2.63e-17	63
Relaxin signaling pathway	4.24e-17	63
Toll-like receptor signaling pathway	5.4e-17	55
Non-small cell lung cancer	6.37e-17	44
ErbB signaling pathway	1.91e-16	48
T cell receptor signaling pathway	2.98e-16	54
Endometrial cancer	3.44e-16	38
Thyroid hormone signaling pathway	4.77e-16	59
Rap1 signaling pathway	6.03e-16	84
Platinum drug resistance	9.4e-16	43
Apoptosis	9.83e-16	63
Salmonella infection	2.33e-15	93
Transcriptional misregulation in cancer	2.59e-15	78
Hippo signaling pathway	4.27e-15	68
Ras signaling pathway	4.78e-15	88
Th17 cell differentiation	1.13e-14	53
Chemokine signaling pathway	3.15e-14	76
Viral carcinogenesis	3.75e-14	79
Pathogenic Escherichia coli infection	4.54e-14	77
Alcoholic liver disease	4.76e-14	62
Cell cycle	8.65e-14	57
Autophagy - animal	1.26e-13	61
Chemical carcinogenesis - receptor activation	1.26e-13	80
Longevity regulating pathway	3.33e-13	45
Parathyroid hormone synthesis, secretion and action	4.49e-13	50
Non-alcoholic fatty liver disease	1.46e-12	63
Growth hormone synthesis, secretion and action	1.46e-12	53
Insulin signaling pathway	1.59e-12	58
Leishmaniasis	2.45e-12	40
NOD-like receptor signaling pathway	3.14e-12	70
TGF-beta signaling pathway	3.74e-12	45
Regulation of actin cytoskeleton	6.14e-12	78
Influenza A	6.39e-12	66
Tuberculosis	9.39e-12	68
Apelin signaling pathway	1.16e-11	57
Alzheimer disease	1.38e-11	116
Adherens junction	1.46e-11	37

Coronavirus disease - COVID-19	2.65e-11	80
AMPK signaling pathway	3.14e-11	51
Axon guidance	5.03e-11	67
Wnt signaling pathway	6.06e-11	63
Estrogen signaling pathway	9.88e-11	55
mTOR signaling pathway	1.72e-10	59
NF-kappa B signaling pathway	2.45e-10	45
Fc epsilon RI signaling pathway	4.41e-10	34
Progesterone-mediated oocyte maturation	4.41e-10	44
Cushing syndrome	5.34e-10	58
B cell receptor signaling pathway	6.21e-10	38
Sphingolipid signaling pathway	1.04e-09	48
Epithelial cell signaling in Helicobacter pylori infection	1.15e-09	34
Diabetic cardiomyopathy	1.37e-09	69
Amoebiasis	1.63e-09	43
Th1 and Th2 cell differentiation	2.15e-09	40
Longevity regulating pathway - multiple species	2.66e-09	31
VEGF signaling pathway	2.93e-09	30
p53 signaling pathway	4.43e-09	34
Legionellosis	5.39e-09	29
Pathways of neurodegeneration - multiple diseases	9.21e-09	127
GnRH signaling pathway	1.18e-08	39
Adipocytokine signaling pathway	1.48e-08	32
Pertussis	1.56e-08	34
Apoptosis - multiple species	1.57e-08	20
Choline metabolism in cancer	1.84e-08	40
RIG-I-like receptor signaling pathway	2.23e-08	32
Bacterial invasion of epithelial cells	2.27e-08	34
cAMP signaling pathway	2.71e-08	70
Chemical carcinogenesis - reactive oxygen species	4.07e-08	70
Platelet activation	4.76e-08	46
Inflammatory bowel disease	4.76e-08	30
Thyroid cancer	6.92e-08	21
JAK-STAT signaling pathway	7.28e-08	55
Insulin resistance	1.31e-07	41
Melanogenesis	5.26e-07	38
Oxytocin signaling pathway	5.59e-07	51
cGMP-PKG signaling pathway	5.93e-07	54
Mitophagy - animal	7.55e-07	30
Phospholipase D signaling pathway	9.53e-07	49
Basal cell carcinoma	1.48e-06	27
Fc gamma R-mediated phagocytosis	1.55e-06	36
Type II diabetes mellitus	1.65e-06	22
Malaria	9.47e-06	22
Gap junction	1.05e-05	32
Natural killer cell mediated cytotoxicity	1.55e-05	42
Antifolate resistance	1.58e-05	16
Hypertrophic cardiomyopathy	1.78e-05	32
Necroptosis	2.19e-05	48

GnRH secretion	2.68e-05	25
Leukocyte transendothelial migration	3.87e-05	37
Notch signaling pathway	6.12e-05	23
Autophagy - other	0.000127	15
Neutrophil extracellular trap formation	0.00018	52
Cholinergic synapse	0.000188	35
Oocyte meiosis	0.000198	39
ECM-receptor interaction	0.00022	29
Adrenergic signaling in cardiomyocytes	0.000229	43
Aldosterone-regulated sodium reabsorption	0.000232	16
Rheumatoid arthritis	0.000253	30
Viral myocarditis	0.000253	22
Dopaminergic synapse	0.000504	38
Cytosolic DNA-sensing pathway	0.000567	22
Inflammatory mediator regulation of TRP channels	0.000701	30
Long-term depression	0.00074	21
African trypanosomiasis	0.000854	15
Ferroptosis	0.000915	16
Viral protein interaction with cytokine and cytokine receptor	0.001	30
Dilated cardiomyopathy	0.00108	29
Allograft rejection	0.00117	15
Thermogenesis	0.00161	57
Arrhythmogenic right ventricular cardiomyopathy	0.00192	24
Ubiquitin mediated proteolysis	0.00223	38
Alcoholism	0.00267	47
Glucagon signaling pathway	0.00324	30
Long-term potentiation	0.00354	21
Prion disease	0.00456	63
Cytokine-cytokine receptor interaction	0.0051	67
Amphetamine addiction	0.00521	21
Hedgehog signaling pathway	0.00524	18
Regulation of lipolysis in adipocytes	0.00524	18
Tight junction	0.00561	42
Aldosterone synthesis and secretion	0.00675	27
Cocaine addiction	0.0073	16
Serotonergic synapse	0.00991	30
Graft-versus-host disease	0.0102	14
Type I diabetes mellitus	0.0128	14
Parkinson disease	0.0143	59
Thyroid hormone synthesis	0.0143	21
Calcium signaling pathway	0.0143	54
Circadian rhythm	0.0143	11
Spinocerebellar ataxia	0.0146	35
Gastric acid secretion	0.0165	21
Phagosome	0.0221	36
Renin secretion	0.0237	19
Endocytosis	0.0241	55
Hematopoietic cell lineage	0.0274	25
Carbohydrate digestion and absorption	0.0278	14

Protein processing in endoplasmic reticulum	0.0305	39
Antigen processing and presentation	0.0423	20
Vascular smooth muscle contraction	0.0455	31
Bile secretion	0.0484	22