

List of O-Reactions and TS-Reactions

Type of Reactions	Reactions numbers in Recon1	Reactions Name in Recon1	References
O-Reaction	1	ornithine transport via diffusion (extracellular to cytosol)	1
O-Reaction	8	Na ⁺ / iodide cotransport	2
O-Reaction	9	nucleoside-diphosphatase (UTP), extracellular	3
O-Reaction	33	maltose transport (uniport)	4
O-Reaction	42	nucleoside-diphosphate kinase (ATP:GDP)	2, 5
O-Reaction	59	Biotin transport via sodium symport	5
O-Reaction	73	24R-Vitamin D-25-hydroxylase (D3)	2
O-Reaction	100	methylenetetrahydrofolate dehydrogenase (NADP), mitochondrial	5
O-Reaction	104	fatty acyl-CoA synthase (n-C10:0CoA)	2, 6, 7
O-Reaction	117	malic enzyme (NADP), mitochondrial	8
O-Reaction	119	Platelet-activating factor acetylhydrolase	3
O-Reaction	143	Arachidonate 5-lipoxygenase	9
O-Reaction	159	acetyl-CoA carboxylase	7, 8, 10, 11
O-Reaction	183	L-pipecolate oxidase, peroxisomal	5
O-Reaction	209	Creatine transport (sodium symport) (2:1)	5
O-Reaction	233	sodium/ammonium proton antiporter	1, 12, 13
O-Reaction	255	cholesterol efflux (ATP depedent)	5
O-Reaction	263	dihydroorotase	5
O-Reaction	279	pyridoxal kinase	5
O-Reaction	283	myo-inositol 3-phosphatase	5
O-Reaction	287	Acetoacetate mitochondrial transport via H ⁺ symport	5
O-Reaction	291	nucleoside-diphosphatase (UDP), extracellular	3
O-Reaction	302	purine-nucleoside phosphorylase (Adenosine)	5
O-Reaction	314	fatty acyl-CoA synthase (n-C8:0CoA), lumped reaction	2, 6, 7
O-Reaction	317	nucleoside-diphosphate kinase (ATP:dGDP)	2, 5
O-Reaction	318	3,5-cyclic-nucleotide phosphodiesterase	5, 14
O-Reaction	319	3-Mercaptolactate:NAD ⁺ oxidoreductase	5, 15
O-Reaction	328	phosphatidylinositol phospholipase C	2
O-Reaction	353	Platelet-activating factor acetylhydrolase	5
O-Reaction	358	Methionine/Leucine exchange (Met in)	5
O-Reaction	360	K ⁺ -Cl ⁻ cotransporter (NH ₄ ⁺)	5
O-Reaction	369	T3 transport via bicarbonate countertransport	5
O-Reaction	372	mannose transport (uniport)	5
O-Reaction	375	citrate transport, mitochondrial	5
O-Reaction	390	nucleoside-diphosphatase (GDP), extracellular	3
O-Reaction	399	Ceramide glucosyltransferase	16
O-Reaction	404	pyrimidine-nucleoside phosphorylase (uracil)	5
O-Reaction	407	deoxyuridine kinase (ATP:Deoxyuridine)	5
O-Reaction	413	choline phosphatase	16
O-Reaction	434	Urea transport via facilitate diffusion	1, 2, 13
O-Reaction	435	L-lactate transport via diffusion (cytosol to mitochondria)	5
O-Reaction	445	transaldolase	5
O-Reaction	456	D-galactose transport via proton symport	1, 13
O-Reaction	466	L-threonine via sodium symport	5
O-Reaction	475	Urea transport via diffusion	5
O-Reaction	514	myo-inositol 1-phosphatase	5
O-Reaction	515	billirubin beta-diglucuronide transport MDR	5
O-Reaction	524	nucleotide phosphatase	5
O-Reaction	538	aconitase	15
O-Reaction	582	ATP diphosphohydrolase	2, 13
O-Reaction	585	L-glutamine reversible transport via sodium symport	5
O-Reaction	586	prostaglandin transport via bicarbonate countertransport	5
O-Reaction	612	acetone mitochondrial transport via proton symport	5
O-Reaction	664	nucleoside-diphosphate kinase (ATP:dUDP)	2, 5
O-Reaction	688	Hydroxymethylglutaryl CoA reductase (ir)	17
O-Reaction	701	C181 fatty acid activation	5
O-Reaction	705	nucleoside-diphosphatase (IDP), extracellular	3
O-Reaction	707	nucleoside-diphosphate kinase (ATP:dCDP)	2, 5
O-Reaction	724	ADP/ATP transporter, mitochondrial	5
O-Reaction	756	nucleoside-diphosphate kinase (ATP:IDP)	2, 5
O-Reaction	762	glutamate 5-kinase (m)	1, 5
O-Reaction	776	Alanine-Sodium symporter	1, 5, 13
O-Reaction	782	Isocitrate dehydrogenase (NADP ⁺)	5, 13, 15, 18
O-Reaction	794	L-lactate reversible transport via proton symport	5, 6
O-Reaction	825	5-Methyltetrahydrofolate transport via receptor binding and protolysis	5
O-Reaction	830	L-serine via sodium symport	5
O-Reaction	839	adenosylhomocysteinase	5
O-Reaction	842	glycine-cleavage complex (lipoylprotein), mitochondrial	5
O-Reaction	860	glucose-6-phosphate isomerase	5
O-Reaction	893	citrate transport, mitochondrial	5

O-Reaction	903	glucose transport (uniport)	5
O-Reaction	925	purine-nucleoside phosphorylase (Guanosine)	5
O-Reaction	931	nucleoside-diphosphate kinase (ATP:dTDP)	2, 5
O-Reaction	932	nucleoside-diphosphate kinase (ATP:dIDP), nuclear	2, 5, 19
O-Reaction	955	glycine transport via sodium symport	5
O-Reaction	962	phosphoribosylglycinamide synthase	5
O-Reaction	973	Nitric Oxide Synthase (intermediate forming)	6, 20
O-Reaction	1044	Diphosphoglycerate phosphatase	4
O-Reaction	1065	glucuronidated compound transport	5
O-Reaction	1075	phosphoglycerate dehydrogenase	5, 15, 21
O-Reaction	1078	glyceraldehyde-3-phosphate dehydrogenase	1, 5, 22
O-Reaction	1083	beta-N-acetylhexosaminidase, lysosomal	2
O-Reaction	1090	nucleoside-diphosphate kinase (ATP:GDP), nuclear	2, 5, 19
O-Reaction	1092	prostaglandine E1 transport (ATP-dependent)	2, 3, 5
O-Reaction	1094	phosphofructokinase	5, 21
O-Reaction	1106	cGMP transport (ATP-dependent)	5
O-Reaction	1110	H2O transport, nuclear	1, 13
O-Reaction	1128	L-arginine transport via diffusion (extracellular to cytosol)	1, 5, 13
O-Reaction	1137	choline phosphatase	16
O-Reaction	1170	Choline kinase	1
O-Reaction	1180	L-lactate dehydrogenase	5, 15, 21
O-Reaction	1188	enolase	5, 23
O-Reaction	1189	Arachidonate 5-lipoxygenase	9
O-Reaction	1194	purine-nucleoside phosphorylase (Inosine)	5
O-Reaction	1200	phosphoribosylaminoimidazole synthase	5
O-Reaction	1213	phosphoribosylaminoimidazolecarboxamide formyltransferase	3
O-Reaction	1233	purine-nucleoside phosphorylase (Deoxyinosine)	5
O-Reaction	1242	estradiol glucuronide transport via bicarbonate countertransport	5
O-Reaction	1248	fatty-acid--CoA ligase (octanoate)	3
O-Reaction	1264	fatty-acyl-CoA synthase (n-C12:0CoA)	2, 6, 14
O-Reaction	1270	phosphatidylinositol 4,5-bisphosphate 3-kinase	2, 3
O-Reaction	1279	methenyltetrahydrikate cyclohydrolase, mitochondrial	5
O-Reaction	1280	Prostaglandin G/H synthase	1, 2, 9, 16, 20
O-Reaction	1298	nucleoside-diphosphate kinase (ATP:dADP)	2, 5
O-Reaction	1301	D-fructose transport in via uniport	5
O-Reaction	1308	estrone 3-sulfate transport via bicarbonate countertransport	5
O-Reaction	1331	sodium transport (uniport)	1, 2, 13
O-Reaction	1339	Squalene epoxidase, endoplasmic reticular (NADP)	5
O-Reaction	1356	purine-nucleoside phosphorylase (Deoxyguanosine)	5
O-Reaction	1362	phospholipase A2	3, 16
O-Reaction	1389	pyruvate reversible transport via proton symport	5, 6
O-Reaction	1390	nucleoside-diphosphate kinase (ATP:dUDP), nuclear	2, 5, 19
O-Reaction	1394	GMP synthase	5
O-Reaction	1398	glycine-cleavage system (lipoamide) irreversible, mitochondrial	5
O-Reaction	1416	carboxylic acid dissociation	2, 4
O-Reaction	1417	aldehyde dehydrogenase (acetaldehyde, NAD), mitochondrial	1, 3
O-Reaction	1418	purine-nucleoside phosphorylase (Xanthosine)	5
O-Reaction	1423	D-glucose transport in via proton symport	1, 13
O-Reaction	1438	phosphatidylinositol 3-kinase	2, 3, 6, 14
O-Reaction	1453	Acetyl-CoA carboxylase, beta isoform	7, 8, 10, 11
O-Reaction	1488	arachidonic acid activation	3
O-Reaction	1494	cytidine kinase (ATP)	5
O-Reaction	1495	fatty-acid--CoA ligase (tetradecanoate)	3
O-Reaction	1503	acetoacetate transport via proton symport	5
O-Reaction	1541	triose-phosphate isomerase	5
O-Reaction	1564	L-phenylalanine transport in via sodium symport	1, 13
O-Reaction	1568	methylenetetrahydrofolate dehydrogenase (NAD), mitochondrial	5
O-Reaction	1580	fatty-acyl-CoA synthase (n-C16:0CoA)	2, 6, 7
O-Reaction	1602	K+-Cl- cotransport	5
O-Reaction	1609	glycine-cleavage complex (lipoamide), mitochondrial	5
O-Reaction	1623	transketolase	6
O-Reaction	1629	phospholipase A2	16
O-Reaction	1645	L-asparagine transport in via sodium symport	5
O-Reaction	1681	fatty-acid--CoA ligase	3
O-Reaction	1685	L-methionine transport in via sodium symport	5
O-Reaction	1690	fatty-acid--CoA ligase	3
O-Reaction	1725	ATP synthase (four protons for one ATP)	5, 24-26
O-Reaction	1731	pyridoxamine kinase	5
O-Reaction	1756	ribonucleoside-diphosphate reductase (UDP)	5, 27, 28
O-Reaction	1771	L-lactate dehydrogenase	15, 29
O-Reaction	1778	prostaglandine E2 transport (ATP-dependent)	2, 3, 5

O-Reaction	1781	hexokinase (D-mannose:ATP)	5
O-Reaction	1782	phosphoglycerate mutase	4, 21
O-Reaction	1789	purine-nucleoside phosphorylase	5
O-Reaction	1796	monoacylglycerol acyltransferase	30
O-Reaction	1797	beta-N-acetylhexosaminidase, lysosomal	2
O-Reaction	1807	folate reductase	5, 31
O-Reaction	1810	Heme oxygenase 1	15
O-Reaction	1820	C160 fatty acid activation	5
O-Reaction	1822	adenylate kinase, mitochondrial	5
O-Reaction	1830	carbamoyl-phosphate synthase (glutamine-hydrolysing)	5
O-Reaction	1853	Butyrate mitochondrial transport via proton symport, reversible	5
O-Reaction	1856	Na ⁺ -K ⁺ -Cl ⁻ cotransport (NH ₄ ⁺)	5
O-Reaction	1877	CTP synthase (glutamine)	16
O-Reaction	1906	L-leucine transport in via sodium symport	1, 5, 13
O-Reaction	1907	galactose transport (uniport)	5
O-Reaction	1916	chloride transport via bicarbonate countertransport	5
O-Reaction	1957	transketolase	6
O-Reaction	1970	nucleoside-diphosphatase (dUDP)	5
O-Reaction	1984	pyridoxine kinase	5
O-Reaction	1995	aspartate-glutamate mitochondrial shuttle	5
O-Reaction	1996	6-phosphofructo-2-kinase	6, 32
O-Reaction	1999	gamma-glutamylcysteine synthetase	13
O-Reaction	2005	phosphatidylinositol-5-phosphate 3-kinase	2, 3
O-Reaction	2007	sphingosine kinase 2	16
O-Reaction	2011	phosphoglycerate kinase	5, 15
O-Reaction	2012	Na ⁺ /Proline-L symporter	5
O-Reaction	2015	glycogenin self-glucosylation	33
O-Reaction	2019	thymidine kinase (ATP:thymidine)	5
O-Reaction	2034	glutamine-fructose-6-phosphate transaminase	5
O-Reaction	2036	glucosamine transport (uniport)	5
O-Reaction	2044	taurocholate transport via bicarbonate countertransport	5
O-Reaction	2052	nucleoside-diphosphate kinase (ATP:dIDP)	2, 5
O-Reaction	2054	ubiquinol-6 cytochrome c reductase, Complex III	5
O-Reaction	2062	pyrroline-5-carboxylate reductase (m)	5, 34
O-Reaction	2065	glyoxylate oxidase	5, 15
O-Reaction	2094	Biotin reversible transport via proton symport	5
O-Reaction	2097	nucleoside-diphosphate kinase (ATP:UDP), nuclear	2, 5, 19
O-Reaction	2103	phosphoribosylaminoimidazole carboxylase	5, 27
O-Reaction	2123	cystathionine beta-synthase	5
O-Reaction	2133	ATP-Citrate lyase	21, 24
O-Reaction	2148	adenylate cyclase	5
O-Reaction	2149	phosphoribosylglycinamide formyltransferase	5
O-Reaction	2156	bicarbonate transport (Na/HCO ₃ 1:2 cotransport)	5
O-Reaction	2169	cysteinesulfinate-aspartate mitochondrial shuttle	5
O-Reaction	2187	acetone transport via proton symport	5, 6
O-Reaction	2195	phosphatidylinositol 4-phosphate 3-kinase	2, 3
O-Reaction	2213	sphingolipid long chain base kinase (sphinganine)	16
O-Reaction	2214	superoxide dismutase, nuclear	1
O-Reaction	2218	fatty-acyl-CoA synthase (n-C14:0CoA)	2, 6, 7
O-Reaction	2234	phosphoribosylaminoimidazolesuccinocarboxamide synthase	5, 27
O-Reaction	2245	L-Tryptophan:oxygen 2,3-oxidoreductase (decyclizing)	23
O-Reaction	2264	aspartate carbamoyltransferase (reversible)	5
O-Reaction	2270	L-alanine transaminase	35, 36
O-Reaction	2286	malic enzyme (NADP)	8
O-Reaction	2307	Fructose-2,6-bisphosphate 2-phosphatase	6, 32
O-Reaction	2323	ATP diphosphohydrolase	2, 13
O-Reaction	2325	glycine-cleavage complex (lipoylprotein), mitochondrial	5
O-Reaction	2337	nucleoside-diphosphate kinase (ATP:dGDP), nuclear	2, 5, 19
O-Reaction	2342	3,5-cyclic-nucleotide phosphodiesterase	14
O-Reaction	2344	nucleoside-diphosphate kinase (ATP:dCDP), nuclear	2, 5, 19
O-Reaction	2364	L-lactate transport, mitochondrial	5
O-Reaction	2368	hydroxypyruvate reductase (NADH)	5, 15
O-Reaction	2428	pyruvate peroxisomal transport via proton symport	5
O-Reaction	2439	choline phosphatase	16
O-Reaction	2451	17-beta-D-glucuronide transport (ATP-dependent)	2, 3, 5
O-Reaction	2455	3-Dehydroshinganine reductase	3
O-Reaction	2456	galactose transport via sodium symport	1, 13
O-Reaction	2464	hexokinase (D-glucose:ATP)	5-7, 15, 22
O-Reaction	2483	superoxide dismutase, peroxisome	1
O-Reaction	2504	ADPribose diphosphatase	5
O-Reaction	2519	nucleoside-diphosphate kinase (ATP:CDP)	2, 5

O-Reaction	2549	Pantothenate sodium symporter II	5
O-Reaction	2572	phosphatidylinositol 4-phosphate phospholipase C	2
O-Reaction	2577	hexokinase (D-fructose:ATP)	5-7, 15, 22
O-Reaction	2596	L-lysine transport via diffusion (extracellular to cytosol)	1, 13
O-Reaction	2632	superoxide dismutase	1
O-Reaction	2634	2-Hydroxybutyrate:NAD+ oxidoreductase	5
O-Reaction	2645	Aconitate hydratase	15
O-Reaction	2702	L-glutamate reversible transport via proton symport, mitochondrial	5
O-Reaction	2725	N-acylsphingosine amidohydrolase	16
O-Reaction	2741	3,5-cyclic-nucleotide phosphodiesterase, Nucleus	5
O-Reaction	2742	lactoylglutathione lyase	1
O-Reaction	2808	Butyrate transport via proton symport, reversible	5
O-Reaction	2810	bilirubin monoglucuronide transport MDR	5
O-Reaction	2831	nucleoside-diphosphate kinase (ATP:UDP)	2, 5
O-Reaction	2844	ribonucleoside-diphosphate reductase (CDP)	5, 27, 28
O-Reaction	2852	glycine-cleavage complex (lipoamide), mitochondrial	5
O-Reaction	2858	spermine synthase	5
O-Reaction	2866	malic enzyme (NAD), mitochondrial	8
O-Reaction	2873	hydroxymethylbilane synthase	5
O-Reaction	2878	adenosylmethionine decarboxylase	5
O-Reaction	2895	24R-Vitamin D-25-hydroxylase (D2)	2
O-Reaction	2899	phosphatidylinositol 4,5-bisphosphate phospholipase C	2
O-Reaction	2902	dehydroascorbate transport (uniport)	5
O-Reaction	2908	ribonucleoside-diphosphate reductase (GDP)	5, 27, 28
O-Reaction	2910	T4 transport via bicarbonate countertransport	5
O-Reaction	2941	dihydrofolate reductase	5
O-Reaction	2951	Prostaglandin G/H synthase	1, 2, 9, 16, 20
O-Reaction	2959	Phosphoenolpyruvate carboxykinase (GTP)	29, 37
O-Reaction	2987	CTP synthase (NH3)	5, 16
O-Reaction	3038	purine-nucleoside phosphorylase (Deoxyadenosine)	5
O-Reaction	3055	uridine kinase (ATP:Uridine)	5
O-Reaction	3070	pyrroline-5-carboxylate reductase (m)	5, 34
O-Reaction	3101	Phosphoenolpyruvate carboxykinase (GTP)	29
O-Reaction	3121	Prostaglandin-H2 D-isomerase [Precursor]	38
O-Reaction	3123	2-hydroxybutyrate cotransport with proton	5, 6
O-Reaction	3164	b-ketoacyl synthetase (palmitate, n-C16:0)	2, 6, 7
O-Reaction	3202	phosphatidylinositol 4,5-bisphosphate 3-kinase, nuclear	6, 14
O-Reaction	3203	urea, water cotransport	1, 13
O-Reaction	3248	phosphoserine phosphatase (L-serine)	5
O-Reaction	3267	glutamate-5-semialdehyde dehydrogenase (m)	1, 5
O-Reaction	3271	glutaminase (mitochondrial)	1, 5, 21
O-Reaction	3289	sulfate transport via bicarbonate countertransport	5
O-Reaction	3296	asparagine synthase (glutamine-hydrolysing)	5
O-Reaction	3316	bicarbonate transport (Na/HCO3 1:3 cotransport)	5
O-Reaction	3338	glycerol-3-phosphate acyltransferase	39
O-Reaction	3373	D-lactate transport via proton symport	5, 6
O-Reaction	3405	beta-N-acetylhexosaminidase, lysosomal	2
O-Reaction	3410	phosphoserine transaminase	5
O-Reaction	3427	glycerol-3-phosphate dehydrogenase (NAD)	36
O-Reaction	3428	phosphate transport in/out via three Na+ symporter	3, 5
O-Reaction	3442	dTMP kinase	5
O-Reaction	3451	glycine-cleavage complex (lipoylprotein) irreversible, mitochondrial	5
O-Reaction	3459	C180 fatty acid activation	3
O-Reaction	3461	cAMP transport (ATP-dependent)	5
O-Reaction	3468	nucleoside-diphosphate kinase (ATP:dTDP), nuclear	2, 5, 19
O-Reaction	3474	nucleoside-diphosphate kinase (ATP:dADP), nuclear	2, 5, 19
O-Reaction	3488	pyruvate kinase	5, 14, 21, 40
O-Reaction	3511	cytochrome c oxidase, mitochondrial Complex IV	3, 5, 18, 41
O-Reaction	3512	glycogen synthase (ggn -> glygn1)	33
O-Reaction	3529	nucleoside-triphosphatase (GTP)	3
O-Reaction	3554	FMN adenyltransferase	5
O-Reaction	3558	myo-inositol 4-phosphatase	5
O-Reaction	3562	nucleoside-diphosphate kinase (ATP:CDP),nuclear	2, 5, 19
O-Reaction	3580	sodium proton antiporter (H:NA is 1:1)	12
O-Reaction	3583	IMP cyclohydrolase	3
O-Reaction	3587	nucleoside-diphosphate kinase (ATP:IDP), nuclear	2, 5, 19
O-Reaction	3593	thymidylate synthase	2, 3, 5
O-Reaction	3633	hexokinase (D-glucosamine:ATP)	5
O-Reaction	3635	ribonucleoside-diphosphate reductase (ADP)	5, 27, 28
O-Reaction	3638	superoxide dismutase	5, 42
O-Reaction	3671	Diphosphoglyceromutase	4

O-Reaction	3690	Nitric Oxide Synthase (NO forming)	6, 11
O-Reaction	3701	fatty-acyl-CoA synthase (n-C18:0CoA)	2, 6, 7
O-Reaction	3725	bile acid intracellular transport	5
O-Reaction	3733	methylcrotonoyl-CoA carboxylase, mitochondrial	5
O-Reaction	3735	deoxyuridine phosphorylase	5
TS-Reaction	51	5,10-methylenetetrahydrofolatereductase (NADPH)	2
TS-Reaction	157	xanthine oxidase	2
TS-Reaction	345	13-cis-retinoic acid isomerase	43
TS-Reaction	534	phosphatidylinositol-3,4,5-trisphosphate 3-phosphatase	2, 17, 43, 44
TS-Reaction	798	5-methylthioadenosine phosphorylase	2, 43
TS-Reaction	866	glycine N-methyltransferase	2, 43
TS-Reaction	987	fumarase, mitochondrial	1, 2, 43
TS-Reaction	1012	xanthine oxidase, peroxisomal	2
TS-Reaction	1144	arginase	2, 45, 46
TS-Reaction	1222	Aldose reductase	2, 43
TS-Reaction	1597	Proline dehydrogenase (m)	2, 43
TS-Reaction	1850	fumarase	1, 2, 43
TS-Reaction	1904	xanthine dehydrogenase, peroxisomal	2
TS-Reaction	1937	isocitrate dehydrogenase (NADP)	2, 13, 15, 43
TS-Reaction	2231	Iodide uniport	2, 43
TS-Reaction	3247	testicular 17-beta-hydroxysteroid dehydrogenase	43
TS-Reaction	3258	phosphatidylinositol-3,4,5-trisphosphate 3-phosphatase, nuclear	2, 3, 6, 43, 44
TS-Reaction	3263	17-beta-hydroxysteroid dehydrogenase (type 7)	43
TS-Reaction	3422	proline oxidase (NAD), mitochondrial	2, 43
TS-Reaction	3536	succinate dehydrogenase	1-3, 15, 43
TS-Reaction	3541	Aminoacetone: oxygen oxidoreductase (deaminating) (flavin-containing)	27
TS-Reaction	3552	NADH dehydrogenase, mitochondrial	1, 2, 6, 16, 43, 47
TS-Reaction	62	pyruvate carboxylase	35
TS-Reaction	188	inositol transport via sodium symport	43
TS-Reaction	472	pyruvate mitochondrial transport via proton symport	1, 48
TS-Reaction	684	Glycine betaine transport via diffusion (mitochondria to cytosol)	1, 12, 21
TS-Reaction	812	Fumarate:thiosulfate antiport, mitochondrial	35
TS-Reaction	1288	Isocitrate dehydrogenase (NAD+)	13, 15
TS-Reaction	1699	fumarate transport, mitochondrial	16
TS-Reaction	1794	sphingomyelin phosphodiesterase 3, neutral membrane (neutral sphingomyelinase II)	35
TS-Reaction	1819	Glycine betaine exchange	35
TS-Reaction	1885	2-oxoglutarate dehydrogenase	35
TS-Reaction	2050	cytochrome P450 lanosterol 14-alpha-demethylase	1
TS-Reaction	2088	citrulline mitochondrial transport via proton antiport	35
TS-Reaction	2225	serine C-palmitoyltransferase	16
TS-Reaction	2233	argininosuccinate lyase	35
TS-Reaction	2293	argininosuccinate synthase	35
TS-Reaction	2516	phosphatidylinositol-3,5-bisphosphate 3-phosphatase	43
TS-Reaction	2582	L-asparaginase (mitochondrial)	29
TS-Reaction	2641	pyruvate dehydrogenase	35
TS-Reaction	2727	ornithine mitochondrial transport exchange with citruline	35
TS-Reaction	2812	betaine-aldehyde dehydrogenase, mitochondrial	35
TS-Reaction	2884	Fumarate:sulfite antiport, mitochondrial	13, 15, 35
TS-Reaction	3042	choline dehydrogenase (FAD acceptor), mitochondrial	35
TS-Reaction	3278	Fumarate:sulfate antiport, mitochondrial	17
TS-Reaction	3521	Betaine transport (sodium symport) (2:1)	35

References:

1. N. Hammoudi, K. B. Ahmed, C. Garcia-Prieto and P. Huang, *Chinese journal of cancer*, 2011, **30**, 508-525.
2. M. E. Higgins, M. Claremont, J. E. Major, C. Sander and A. E. Lash, *Nucleic acids research*, 2007, **35**, D721-726.
3. T. Santarius, J. Shipley, D. Brewer, M. R. Stratton and C. S. Cooper, *Nature reviews. Cancer*, 2010, **10**, 59-64.
4. R. A. Gatenby and R. J. Gillies, *Nature reviews. Cancer*, 2004, **4**, 891-899.
5. R. Possemato, K. M. Marks, Y. D. Shaul, M. E. Pacold, D. Kim, K. Birsoy, S. Sethumadhavan, H. K. Woo, H. G. Jang, A. K. Jha, W. W. Chen, F. G. Barrett, N. Stransky, Z. Y. Tsun, G. S. Cowley, J.

- Barretina, N. Y. Kalaany, P. P. Hsu, K. Ottina, A. M. Chan, B. Yuan, L. A. Garraway, D. E. Root, M. Mino-Kenudson, E. F. Brachtel, E. M. Driggers and D. M. Sabatini, *Nature*, 2011, **476**, 346-350.
6. R. J. Gillies, I. Robey and R. A. Gatenby, *Journal of nuclear medicine : official publication, Society of Nuclear Medicine*, 2008, **49 Suppl 2**, 24S-42S.
7. F. P. Kuhajda, *Nutrition*, 2000, **16**, 202-208.
8. S. M. Jeon, N. S. Chandel and N. Hay, *Nature*, 2012, **485**, 661-665.
9. D. Wang and R. N. Dubois, *Nature reviews. Cancer*, 2010, **10**, 181-193.
10. A. Beckers, S. Organe, L. Timmermans, K. Scheys, A. Peeters, K. Brusselmans, G. Verhoeven and J. V. Swinnen, *Cancer research*, 2007, **67**, 8180-8187.
11. C. Wang, S. Rajput, K. Watabe, D. F. Liao and D. Cao, *Front Biosci (Schol Ed)*, 2010, **2**, 515-526.
12. G. H. Lee, C. Yan, S. J. Shin, S. C. Hong, T. Ahn, A. Moon, S. J. Park, Y. C. Lee, W. H. Yoo, H. T. Kim, D. S. Kim, S. W. Chae, H. R. Kim and H. J. Chae, *Oncogene*, 2010, **29**, 2130-2141.
13. R. A. Cairns, I. S. Harris and T. W. Mak, *Nature reviews. Cancer*, 2011, **11**, 85-95.
14. A. Najafov and D. R. Alessi, *Proceedings of the National Academy of Sciences of the United States of America*, 2010, **107**, 19135-19136.
15. K. Hiller and C. M. Metallo, *Current opinion in biotechnology*, 2013, **24**, 60-68.
16. B. Ogretmen and Y. A. Hannun, *Nature reviews. Cancer*, 2004, **4**, 604-616.
17. C. C. Cook, A. Kim, S. Terao, A. Gotoh and M. Higuchi, *Cell death & disease*, 2012, **3**, e258.
18. D. I. Benjamin, B. F. Cravatt and D. K. Nomura, *Cell metabolism*, 2012, **16**, 565-577.
19. S. Nakamori, O. Ishikawa, H. Ohhigashi, M. Kameyama, H. Furukawa, Y. Sasaki, H. Inaji, M. Higashiyama, S. Imaoka, T. Iwanaga and et al., *Clinical & experimental metastasis*, 1993, **11**, 151-158.
20. R. N. Dubois, S. B. Abramson, L. Crofford, R. A. Gupta, L. S. Simon, L. B. Van De Putte and P. E. Lipsky, *FASEB journal : official publication of the Federation of American Societies for Experimental Biology*, 1998, **12**, 1063-1073.
21. H. Cheong, C. Lu, T. Lindsten and C. B. Thompson, *Nature biotechnology*, 2012, **30**, 671-678.
22. M. Guppy, P. Leedman, X. Zu and V. Russell, *The Biochemical journal*, 2002, **364**, 309-315.
23. G. C. Prendergast, *Nature*, 2011, **478**, 192-194.
24. V. Gogvadze, S. Orrenius and B. Zhivotovsky, *Trends in cell biology*, 2008, **18**, 165-173.
25. J. M. Cuezva, M. Krajewska, M. L. de Heredia, S. Krajewski, G. Santamaria, H. Kim, J. M. Zapata, H. Marusawa, M. Chamorro and J. C. Reed, *Cancer research*, 2002, **62**, 6674-6681.
26. M. A. Medina, *The Journal of nutrition*, 2001, **131**, 2539S-2542S; discussion 2550S-2531S.
27. K. Xu, J. Cui, V. Olman, Q. Yang, D. Puett and Y. Xu, *PloS one*, 2010, **5**, e13696.
28. X. Liu, B. Zhou, L. Xue, F. Yen, P. Chu, F. Un and Y. Yen, *Clinical colorectal cancer*, 2007, **6**, 374-381.
29. L. Levin and W. Gevers, *South African medical journal = Suid-Afrikaanse tydskrif vir geneeskunde*, 1981, **59**, 518-521.
30. E. Mosca, R. Alfieri, I. Merelli, F. Viti, A. Calabria and L. Milanese, *BMC Syst Biol*, 2010, **4**, 76.
31. H. M. Berman, J. Westbrook, Z. Feng, G. Gilliland, T. N. Bhat, H. Weissig, I. N. Shindyalov and P. E. Bourne, *Nucleic acids research*, 2000, **28**, 235-242.
32. M. C. Archer, *Genes & cancer*, 2011, **2**, 712-719.
33. J. Luo, *Cancer letters*, 2009, **273**, 194-200.
34. J. M. Phang, W. Liu, C. Hancock and K. J. Christian, *Frontiers in oncology*, 2012, **2**, 60.
35. M. Israel and L. Schwartz, *Molecular cancer*, 2011, **10**, 70.
36. O. Ben-Yoseph, R. S. Badar-Goffer, P. G. Morris and H. S. Bachelard, *The Biochemical journal*, 1993, **291 (Pt 3)**, 915-919.
37. J. Gold, *Oncology*, 1974, **29**, 74-89.

38. J. D. Feala, L. Coquin, D. Zhou, G. G. Haddad, G. Paternostro and A. D. McCulloch, *BMC Syst Biol*, 2009, **3**, 91.
39. J. M. Ellis, D. S. Paul, M. A. Depetrillo, B. P. Singh, D. E. Malarkey and R. A. Coleman, *Toxicologic pathology*, 2012, **40**, 513-521.
40. H. R. Christofk, M. G. Vander Heiden, M. H. Harris, A. Ramanathan, R. E. Gerszten, R. Wei, M. D. Fleming, S. L. Schreiber and L. C. Cantley, *Nature*, 2008, **452**, 230-233.
41. R. C. Krieg, R. Knuechel, E. Schiffmann, L. A. Liotta, E. F. Petricoin, 3rd and P. C. Herrmann, *Proteomics*, 2004, **4**, 2789-2795.
42. P. Huang, L. Feng, E. A. Oldham, M. J. Keating and W. Plunkett, *Nature*, 2000, **407**, 390-395.
43. M. Zhao, J. Sun and Z. Zhao, *Nucleic acids research*, 2013, **41**, D970-976.
44. T. Maehama and J. E. Dixon, *The Journal of biological chemistry*, 1998, **273**, 13375-13378.
45. R. Singh, S. Pervin, A. Karimi, S. Cederbaum and G. Chaudhuri, *Cancer research*, 2000, **60**, 3305-3312.
46. M. Munder, *British journal of pharmacology*, 2009, **158**, 638-651.
47. Y. Yusnita, M. D. Norsiah and A. J. Rahman, *The Malaysian journal of pathology*, 2010, **32**, 103-110.
48. G. Paradies, F. Capuano, G. Palombini, T. Galeotti and S. Papa, *Cancer research*, 1983, **43**, 5068-5071.