Description
phosphoglucomutase (pgm)
glucose-6-phosphate isomerase (pgi)
fructose-1,6-bisphosphatase (glpX)
6-phosphofructokinase 1
fructose-bisphosphate aldolase class II
triosephosphate isomerase (TIM)
glyceraldehyde-3-phosphate dehydrogenase (NADP) (gapN)
glyceraldehyde 3-phosphate dehydrogenase (gapA)
phosphoglycerate kinase (pgk)
2,3-bisphosphoglycerate-independent phosphoglycerate mutase (gpm)
enolase (eno)
pyruvate kinase (pyk)
L-lactate dehydrogenase (ldh)
pyruvate dehydrogenase
pyruvate decarboxylase
aldehyde dehydrogenase (NAD+)
ADP-forming acetyl coenzyme A synthetase I
pyruvate carboxylase (pyc)
citrate synthase(gltA)
aconitate hydratase (acnA)
isocitrate dehydrogenase (icd)
2-oxoglutarate dehydrogenase
succinyl-CoA synthetase
Succinyl-CoA:acetate CoA-transferase
succinate dehydrogenase / fumarate reductase, flavoprotein subunit
acetyl-CoA carboxylase biotin carboxyl carrier protein/fumarate hydratase ,class II
malate dehydrogenase (quinone)
malate dehydrogenase(mdh)
phosphoenolpyruvate carboxykinase (ATP)
gluconate 2-dehydrogenase alpha/gamma chain
choline dehydrogenase
gluconokinase (gntK)
6-phosphogluconate dehydrogenase
ribose 5-phosphate isomerase B
phosphopentomutase(deoB);phosphoglucomutase(pgm)
ribose-phosphate pyrophosphokinase (prsA)
3-hexulose-6-phosphate synthase / 6-phospho-3-hexuloisomerase
6-phospho-3-hexuloisomerase
transaldolase (talA, talB)
Deoxyribose-phosphate aldolase(deoC)
2-Deoxy-D-ribose 1-phosphate 1,5-phosphomutase,
transketolase (tktA, tktB)
transketolase (tktA, tktB)
ribulose-phosphate 3-epimerase (rpe)
mannose-1-phosphate guanylyltransferase
GDP-4-dehydro-6-deoxy-D-mannose reductase
UDP-glucose 4-epimerase (galE)
UTP-glucose-1-phosphate uridylyltransferase(galU, galF)
acetolactate synthase
3-hydroxybutyryl-CoA dehydrogenase (paaH)
enoyl-CoA hydratase
NADH-dependent reduced ferredoxin:NADP_ oxidoreductase
ATP synthase (four protons for one ATP)
Ferredoxin:NAD oxidoreductase
acetyl-CoA C-acetyltransferase (atoB)
3-oxoacid CoA-transferase subunit A/B
3-hydroxybutyrate dehydrogenase (bdh)

menaquinone-specific isochorismate synthase/isochorismate synthase
2-succinyl-5-enolpyruvyl-6-hydroxy-3-cyclohexene-1-carboxylate synthase
2-succinyl-6-hydroxy-2,4-cyclohexadiene-1-carboxylate synthase
O-succinylbenzoate synthase
O-succinylbenzoic acid--CoA ligase
naphthoate synthase
1,4-dihydroxy-2-naphthoyl-CoA hydrolase
1,4-dihydroxy-2-naphthoate octaprenyltransferase
ubiquinone/menaquinone biosynthesis methyltransferase
NAD(P)H dehydrogenase (quinone)
octaprenyl-diphosphate synthase
aspartate aminotransferase (aspB)
glutamine synthetase (glnA)
glutaminase (glsA)
glutamate dehydrogenase
glucosamine-fructose-6-phosphate aminotransferase (isomerizing) (glmS)
amino-acid N-acetyltransferase (argJ)
acetylglutamate kinase (argB)
N-acetyl-gamma-glutamyl-phosphate reductase
acetylornithine aminotransferase (argD)
glutamate N-acetyltransferase / amino-acid N-acetyltransferase
ornithine carbamoyltransferase (argF, argI)
Argininosuccinate synthase
argininosuccinate lyase（argH）
arginase (rocF)
urea carboxylase / allophanate hydrolase
allophanate hydrolase
urease subunit alpha/beta/gamma
ADPribose diphosphatase (nudF)
amidophosphoribosyltransferase
phosphoribosylamine-glycine ligase (purD)
phosphoribosylglycinamide formyltransferase 1 (purN)
phosphoribosylformylglycinamidine synthase (purL) /subunit PurQ / glutaminase
phosphoribosylformylglycinamidine cyclo-ligase
5-(carboxyamino)imidazole ribonucleotide synthase
5-(carboxyamino)imidazole ribonucleotide mutase
phosphoribosylaminoimidazole-succinocarboxamide synthase
adenylosuccinate lyase (purB)
phosphoribosylaminoimidazolecarboxamide formyltransferase / IMP cyclohydrolase
IMP cyclohydrolase(purH)
adenylosuccinate synthase (purA)
adenylosuccinate lyase(purB)
adenylate kinase(adk)
nucleoside-diphosphate kinase (ndk)
ribonucleoside-diphosphate reductase
nucleoside-diphosphate kinase
nucleoside-diphosphate kinase (ndk)
adenylate kinase(adk)
5'-nucleotidase (dAMP)
deoxyadenosine/deoxycytidine kinase
phosphoribosylaminoimidazolecarboxamide formyltransferase / IMP cyclohydrolase
inosine 5'-monophosphate phosphohydrolase
5'-nucleotidase (AMP)
purine-nucleoside phosphorylas(punA)
purine-nucleoside phosphorylas(punA)
adenine aminohydrolase
purine-nucleoside phosphorylas(punA)
IMP dehydrogenase (guaB)

GMP synthase (glutamine-hydrolysing)
guanylate kinase (gmk)
ribonucleoside-diphosphate reductase
nucleoside-diphosphate kinase(ndk)
guanylate kinase(gmk)
deoxyguanosine kinase
purine-nucleoside phosphorylas(punA)
hypoxanthine phosphoribosyltransferase(hpt)
purine-nucleoside phosphorylas(punA)
5'-nucleotidase (GMP)
guanine deaminase(guaD)
xanthine dehydrogenase(YagR)
purine-nucleoside phosphorylas(punA)
5'-nucleotidase (XMP)
xanthine dehydrogenase(YagR)
uricase
5-hydroxyisourate hydrolase
2-oxo-4-hydroxy-4-carboxy-5-ureidoimidazoline decarboxylase
allantoinase
allantoate amidinohydrolase (decarboxylating)|allC; allantoate deiminase
(S)-ureidoglycine---glyoxylate transaminase
allantoicase
urease
2',3'-cyclic-nucleotide 2'-phosphodiesterase
3'-nucleotidase
sulfate adenylyltransferase
adenylylsulfate kinase
5-(carboxyamino)imidazole ribonucleotide synthase (purK)
nucleoside-diphosphate kinase
nucleoside-triphosphate pyrophosphatase(mazG)
XTP/dITP diphosphohydrolase
carbamoyl-phosphate synthase large/small subunit
aspartate carbamoyltransferase catalytic subunit
dihydroorotase (pyrC)
dihydroorotate dehydrogenase (NAD+) catalytic subunit
orotate phosphoribosyltransferase (pyrE)
orotidine-5'-phosphate decarboxylase (pyrF)
5'-nucleotidase (UMP)
uridine phosphorylase
dihydropyrimidine dehydrogenase (NAD+)
dihydropyrimidinase
beta-ureidopropionase
uridine kinase
uridylate kinase (pyrH)
CTP synthase
dCTP deaminase(dcd)
nucleoside-diphosphate kinase(ndk)
CMP/dCMP kinase
5'-nucleotidase (CMP)
cytidine deaminase
cytosine deaminase(codA)
pyrimidine-nucleoside phosphorylase
ribonucleoside-triphosphate reductase
nucleoside-diphosphate kinase(ndk)
dCTP diphosphatase
cytidylate kinase(cmk)
deoxycytidine kinase
5'-nucleotidase (dCMP)

deoxycytidine deaminase
purine-nucleoside phosphorylas(punA)
dCTP deaminase(dcd)
nucleoside-diphosphate kinase(ndk)
ribonucleoside-diphosphate reductase
thymidylate kinase(tmk)
thymidine kinase
5'-nucleotidase (dUMP)
thymidylate synthase (thyA)
thymidylate kinase(tmk)
nucleoside-diphosphate kinase(ndk)
5'-nucleotidase (dTMP)
thymidine phosphorylase
dihydropyrimidine dehydrogenase
dihydropyrimidinase
beta-ureidopropionase
beta-ureidopropionase
asparagine synthase (glutamine-hydrolysing, asnB)
L-asparaginase (ansA, ansB)
L-aspartate oxidase (nadB)
asparagine oxo-acid transaminase
omega-amidase
aspartate racemase
D-aspartate oxidase
argininosuccinate synthase( argG）
omega-amidase
glutamate synthase (NADPH) large/small chain
pantoate--beta-alanine ligase
glutamine-fructose-6-phosphate transaminase(glmS)
carbamoyl-phosphate synthase
1-pyrroline-5-carboxylate dehydrogenase
glutamate decarboxylase
4-aminobutyrate aminotransferase (gabT) / (S)-3-amino-2-methylpropionate transaminase (puu
succinate-semialdehyde dehydrogenase / glutarate-semialdehyde dehydrogenase
hydroxypyruvate reductase
glycerate kinase
D-3-phosphoglycerate dehydrogenase / 2-oxoglutarate reductase
phosphoserine transaminase (serC)
phosphoserine phosphatase (serB)
L-serine dehydratase (sdaA) /threonine dehydratase (ilvA, tdcB)
D-serine dehydratase (dsdA)
serine racemase
tryptophan synthase
glycine hydroxymethyltransferase
glycine dehydrogenase subunit 1
aminomethyltransferase (gcvT)
dihydrolipoamide dehydrogenase(pdhD)
glycine C-acetyltransferase
primary-amine oxidase
threonine aldolase
threonine dehydratase
aspartate kinase(lysC)
aspartate-semialdehyde dehydrogenase(asd)
4-hydroxy-tetrahydrodipicolinate synthase (HTPA synthase)
4-hydroxy-tetrahydrodipicolinate reductase
homoserine dehydrogenase
homoserine dehydrogenase
homoserine kinase

threonine synthase ( thrC)
CDP-diacylglycerol---serine O-phosphatidyltransferase
cystathionine beta-synthase
cystathionine beta-synthase
S-sulfo-L-cysteine synthase (3-phospho-L-serine-dependent)
cysteine synthase A (cysK)
S-sulfo-L-cysteine synthase (O-acetyl-L-serine-dependent)/cysteine synthase A (cysK)
serine O-acetyltransferase (cysE)
L-Serine hydro-lyase
cysteine synthase(cysK)
cysteine lyase
aspartate aminotransferase
malate dehydrogenase
(2R)-sulfolactate sulfo-lyase
cystathionine beta-synthase
thiosulfate/3-mercaptopyruvate sulfurtransferase
2-oxoglutarate-glutamate aminotransferase
aspartate 4-decarboxylase
cysteine-S-conjugate beta-lyase
5-methyltetrahydrofolate--homocysteine methyltransferase(metH)
L-methionine (R)-S-oxide reductase
L-glutamine---4-(methylsulfanyl)-2-oxobutanoate aminotransferase
S-adenosylmethionine synthetase
putative AdoMet-dependent methyltransferase
adenosylhomocysteine nucleosidase
S-ribosylhomocysteine lyase
cystathionine beta-synthase (O-acetyl-L-serine)
Succinyl-CoA:L-homoserine O-succinyltransferase|metA; homoserine O-succinyltransferase
cystathionine gamma-synthase ( metB)
cystathionine gamma-synthase ( metB)
leucine dehydrogenase
2-oxoisovalerate dehydrogenase E1 component alpha subunit
2-oxoisovalerate dehydrogenase E1 component beta subunit
dihydrolipoamide dehydrogenase (pdhD)
2-oxoisovalerate dehydrogenase E2 component (dihydrolipoyl transacylase)
acyl-CoA dehydrogenase
enoyl-CoA hydratase
methylglutaconyl-CoA hydratase
hydroxymethylglutaryl-CoA lyase
3-hydroxyisobutyryl-CoA hydrolase
L-Valine:2-oxoglutarate aminotransferase
2-oxoisocaproate dehydrogenase
dihydrolipoyl dehydrogenase
dihydrolipoyl transacylase
acyl-CoA dehydrogenase
enoyl-CoA hydratase
2-oxoisocaproate dehydrogenase
2-oxoisocaproate dehydrogenase
dihydrolipoyl transacylase
butyryl-CoA dehydrogenase
enoyl-CoA hydratase
3-hydroxyacyl-CoA dehydrogenase
acetyl-CoA acyltransferase (fadA)
propionyl-CoA carboxylase beta chain
methylmalonyl-CoA/ethylmalonyl-CoA epimerase
methylmalonyl-CoA mutase
3-hydroxyacyl-CoA dehydrogenase
L-3-amino-isobutanoate:2-oxoglutarate aminotransferase

aldehyde dehydrogenase (NAD+)
3-isopropylmalate/(R)-2-methylmalate dehydratase
3-isopropylmalate/(R)-2-methylmalate dehydratase
3-isopropylmalate dehydrogenase
L-threonine ammonia-lyase (2-oxobutanoate-forming)
ketol-acid reductoisomerase (ilvC)
ketol-acid reductoisomerase(ilvC)
dihydroxy-acid dehydratase (ilvD)
branched-chain amino acid aminotransferase(ilvE)
acetolactate synthase
ketol-acid reductoisomerase (ilvC)
ketol-acid reductoisomerase (ilvC)
dihydroxy-acid dehydratase (ilvD)
acetolactate synthase
2-isopropylmalate synthase (leuA)
3-isopropylmalate dehydratase
3-isopropylmalate dehydrogenase (leuB)
spontaneous
branched-chain amino acid aminotransferase
2,3,4,5-tetrahydropyridine-2,6-dicarboxylate N-succinyltransferase
2,3,4,5-tetrahydropyridine-2-carboxylate N-succinyltransferase (dapD)
acetylornithine/N-succinyldiaminopimelate aminotransferase (argD)
N-Succinyl-LL-2,6-diaminoheptanedioate amidohydrolase (dapE)
diaminopimelate epimerase (dapF)
diaminopimelate decarboxylase (lysA)
UDP-N-acetylmuramoyl-L-alanyl-D-glutamyl-meso-2,6-diaminopimelate synthetase (murE)
UDP-N-acetylmuramoyl-L-alanyl-D-glutamyl-meso-2,6-diaminopimeloyl-D-alanyl-D-alanine s
N-acetyldiaminopimelate deacetylase
lysine 2-monooxygenase
5-aminopentanamidase
5-aminovalerate aminotransferase DavT
glutarate-semialdehyde dehydrogenase
glutarate-semialdehyde dehydrogenase
glutaryl-CoA dehydrogenase (ETF)
enoyl-CoA hydratase

glutamate-5-semialdehyde dehydrogenase (proA)
ornithine--oxo-acid transaminase
L-glutamate-5-semialdehyde N-acetyltransferase
ornithine cyclodeaminase(ocd)
pyrroline-5-carboxylate reductase
pyrroline-5-carboxylate reductase
prolyl 4-hydroxylase
trans-4-hydroxy-L-proline:quinone oxidoreductase
proline dehydrogenase
delta 1-pyrroline-5-carboxylate dehydrogenase
aspartate aminotransferase (aspB)
2-dehydro-3-deoxyphosphogluconate aldolase / 4-hydroxy-2-oxoglutarate aldolase (eda)
arginine decarboxylase/L-arginine carboxylyase
agmatinase (speB)
putrescine aminotransferase
aminobutyraldehyde dehydrogenase
spermidine:oxygen oxidoreductase
ATP phosphoribosyltransferase (hisG)
phosphoribosyl-ATP pyrophosphohydrolase
phosphoribosyl-AMP cyclohydrolase / phosphoribosyl-ATP pyrophosphohydrolase
phosphoribosylformimino-5-aminoimidazole carboxamide ribotide isomerase
glutamine amidotransferase (hisH) and cyclase (hisF)

imidazoleglycerol-phosphate dehydratase
histidinol-phosphate aminotransferase (hisC)
histidinol-phosphatase (PHP family)
histidinol dehydrogenase (hisD)
histidinol dehydrogenase (hisD)
aromatic-amino-acid transaminase
4-hydroxyphenylpyruvate decarboxylase
primary-amine oxidase
aldehyde dehydrogenase [NAD(P)+]
4-hydroxyphenylacetate 3-monooxygenase
aromatic-amino-acid transaminase
phenylpyruvate carboxy-lyase (phenylacetaldehyde-forming)
Phenylacetaldehyde:NAD+ oxidoreductase
phenylacetate---CoA ligase
3-oxo-5,6-didehydrosuberyl-CoA thiolase
enoyl-CoA hydratase
3-hydroxybutyryl-CoA dehydrogenase (paaH)
3-oxoadipyl-CoA thiolase
3-deoxy-7-phosphoheptulonate synthase
3-dehydroquinate synthase (aroC)
3-dehydroquinate dehydratase II
shikimate 5-dehydrogenase
shikimate kinase
3-phosphoshikimate 1-carboxyvinyltransferase
chorismate synthase
chorismate lyase
anthranilate phosphoribosyltransferase
phosphoribosylanthranilate isomerase
indole-3-glycerol-phosphate synthase
tryptophan synthase
tryptophan synthase
chorismate mutase
prephenate dehydratase
prephenate dehydrogenase
aromatic-amino-acid transaminase
prephenate dehydratase
Aspartate 1-decarboxylase
3-Sulfo-L-alanine carboxy-lyase (taurine-forming)
gamma-glutamyltranspeptidase / glutathione hydrolase
hypotaurine dehydrogenase
sulfate adenylyltransferase
selenate reductase
thioredoxin reductase (NADPH)
methionyl-tRNA synthetase
cysteine desulfurase / selenocysteine lyase
cystathionine gamma-synthase
cystathionine beta-lyase
methionine synthase
cyanoalanine nitrilase
gamma-glutamyltranspeptidase
gamma-glutamyltranspeptidase
glutaminase (glsA)
UDP-N-acetylmuramoylalanine--D-glutamate ligase
alanine racemase
D-alanine-D-alanine ligase
5-oxoprolinase (ATP-hydrolysing) subunit A/B/C
gamma-glutamyltranspeptidase
leucyl aminopeptidase or aminopeptidase N

glutathione peroxidase
glutathione reductase (NADPH)
glutathione transferase
gamma-glutamyltransferase
leucyl aminopeptidase
cysteine-S-conjugate N-acetyltransferase
cysteine-S-conjugate N-acetyltransferase
glucan 1,4-alpha-maltohydrolase
cyclomaltodextrin glucanotransferase
heparin N-sulfotransferase
phosphoglucosamine mutase
glucosamine-1-phosphate N-acetyltransferase
UDP-N-acetylglucosamine diphosphorylase
UDP-N-acetyl-D-glucosamine 4-epimerase
UDP-N-acetylglucosamine 1-carboxyvinyltransferase
UDP-N-acetylmuramate dehydrogenase (murB)
UDP-N-acetylglucosamine 2-epimerase (wecB)
UDP-N-acetyl-D-mannosaminuronic acid dehydrogenase
L-methionine methanethiol-lyase (deaminating;2-oxobutanoate-forming)
glucose-1-phosphate thymidylyltransferase
dTDPglucose 4,6-hydro-lyase,
myo-inositol-1(or 4)-monophosphatase(suhB)
inositol-3-phosphate synthase
UDP-N-acetylmuramate--alanine ligase
UDP-N-acetylmuramoyl-L-alanyl-D-glutamate L-lysine ligase
UDP-N-acetylmuramoyl-tripeptide---D-alanyl-D-alanine ligase
phospho-N-acetylmuramoyl-pentapeptide-transferase (mraY)
UDP-N-acetylglucosamine-N-acetylmuramyl-(pentapeptide) pyrophosphoryl-undecaprenol N-
undecaprenol kinase
undecaprenyl-diphosphatase (bacA)
undecaprenyl diphosphate synthase
Peptidoglycan subunit synthesis
aldehyde dehydrogenase (NAD+)
glycerol dehydrogenase
glycerol kinase
acyl phosphate:glycerol-3-phosphate acyltransferase
phosphate acyltransferase
diacylglycerol kinase
glycerol-3-phosphate dehydrogenase(NADPH,gpsA)
myo-inositol-1(or 4)-monophosphatase(suhB)
phospholipase C(plcC)
glycerol-3-phosphate dehydrogenase
glycerol-3-phosphate cytidylyltransferase
phosphatidate cytidylyltransferase (cdsA)
CDP-diacylglycerol-glycerol-3-phosphate 3-phosphatidyltransferase (pgsA)
phosphatidylglycerophosphatase (pgpA)
phosphatidylserine decarboxylase
phospholipase A1
lysophospholipase(pldB)
glycerophosphodiester phosphodiesterase (Glycerophosphoglycerol)
glycerophosphodiester phosphodiesterase (Glycerophosphoglycerol)
acetyl-CoA carboxylase carboxyl transferase subunit alpha / beta
malate synthase (glcB)
acetyl-CoA synthetase (acs)
Pyruvate dehydrogenase [ubiquinone]
4-oxalocrotonate tautomerase
2-hydroxymuconate-6-semialdehyde dehydrogenase
catechol 2,3-dioxygenase

tartrate dehydratase
tartrate dehydrogenase / decarboxylase / D-malate dehydrogenase
enoyl-CoA hydratase
beta-alanyl-CoA ammonia-lyase
4-aminobutyrate aminotransferase (gabT) / (S)-3-amino-2-methylpropionate transaminase (puu
short-chain acyl-CoA dehydrogenase
dihydrolipoyllysine-residue (2-methylpropanoyl)transferase
2-oxoisocaproate dehydrogenase
2-oxoisocaproate dehydrogenase
L-lactate dehydrogenase
methylisocitrate lyase(prpB)
2-methylisocitrate dehydratase
2-methylcitrate dehydratase(prpD)
2-methylcitrate synthase
Methylmalonyl-CoA carboxyltransferase
succinate dehydrogenase
acetate CoA-transferase
crotonyl-CoA reductase
3-hydroxyacyl-CoA dehydrogenase
pyruvate synthase
dihydrofolate reductase
formate--tetrahydrofolate ligase
formyltetrahydrofolate deformylase
methylenetetrahydrofolate dehydrogenase (NADP+) / methenyltetrahydrofolate cyclohydrolase
methionyl-tRNA formyltransferase
5-formyltetrahydrofolate cyclo-ligase (ADP-forming)
5,10-methylenetetrahydrofolate reductase
aconitate hydratase
2-oxoglutarate ferredoxin oxidoreductase
Phosphomethylpyrimidine synthase
hydroxymethylpyrimidine/phosphomethylpyrimidine kinase
hydroxymethylpyrimidine/phosphomethylpyrimidine kinase
thiamine-phosphate pyrophosphorylase
ribosome biogenesis GTPase / thiamine phosphate phosphatase
thiamine pyrophosphokinase
adenylate kinase
sulfur carrier protein ThiS adenylyltransferase
tRNA uracil 4-sulfurtransferase
1-deoxy-D-xylulose-5-phosphate synthase (dxs)
thiazole synthase
thiazole tautomerase (transcriptional regulator TenI)
2-methyl-4-amino-5-hydroxymethylpyrimidine-diphosphate:2-(2-carboxy-4-methylthiazol-5-yl
hydroxyethylthiazole kinase (thiM)
thiaminase (transcriptional activator TenA)
3,4-dihydroxy 2-butanone 4-phosphate synthase
3,4-dihydroxy 2-butanone 4-phosphate synthase / GTP cyclohydrolase II
diaminohydroxyphosphoribosylaminopyrimidine deaminase / 5-amino-6-(5-phosphoribosylam
5-amino-6-(5-phosphoribosylamino)uracil reductase
5-amino-6-(5-phospho-D-ribitylamino)uracil phosphatase
6,7-dimethyl-8-ribityllumazine synthase
riboflavin synthase (ribE)
riboflavin kinase / FMN adenylyltransferase (ribF)
FMN adenylyltransferase
FMN reductase
aerobic 5,6-dimethylbenzimidazole synthase
pyridoxine kinase
pyridoxamine 5'-phosphate oxidase
pyridoxine kinase

pyridoxal 5'-phosphate synthase pdxS / pdxT subunit
threonine synthase
pyridoxine kinase
pyridoxamine 5'-phosphate oxidase
L-aspartate oxidase
L-aspartate oxidase
L-aspartate oxidase
quinolinate synthase
nicotinate-nucleotide pyrophosphorylase (carboxylating)
nicotinate phosphoribosyltransferase (pncB)
5'-nucleotidase
purine-nucleoside phosphorylase
nicotinate-nucleotide adenylyltransferase
NAD+ synthase (nadE)
NAD+ kinase
nicotinate-nucleotide adenylyltransferase
nicotinamide-nucleotide amidase
purine-nucleoside phosphorylase
5'-nucleotidase
3-methyl-2-oxobutanoate hydroxymethyltransferase
2-dehydropantoate 2-reductase (panE, apbA)
pantoate-β-alanine ligase
type III pantothenate kinase
phosphopantothenoylcysteine decarboxylase / phosphopantothenate--cysteine ligase
phosphopantothenoylcysteine decarboxylase / phosphopantothenate---cysteine ligase
pantetheine-phosphate adenylyltransferase
dephospho-CoA kinase (coaE)
acyl-carrier protein synthase
biotin synthase
biotin--protein ligase
biotin--protein ligase
lipoate---protein ligase
lipoic acid synthetase
lipoyl(octanoyl) transferase
octanoyl-[GcvH]:protein N-octanoyltransferase
6-pyruvoyltetrahydropterin/6-carboxytetrahydropterin synthase
7-carboxy-7-deazaguanine synthase
7-cyano-7-deazaguanine synthase
7-cyano-7-deazaguanine reductase
alkaline phosphatase D (phoD)
GTP cyclohydrolase IA/IB
GTP cyclohydrolase IA/IB
GTP cyclohydrolase I
GTP cyclohydrolase I
GTP cyclohydrolase I
alkaline phosphatase D (phoD)
dihydroneopterin aldolase
ATP:2-amino-4-hydroxy-6-hydroxymethyl-7,8-dihydropteridine
2-Amino-4-hydroxy-6-hydroxymethyl-7,8-dihydropteridine:4-|E2.5.1.15, folP; dihydropteroate
4-amino-4-deoxychorismate lyase
para-aminobenzoate synthetase component I
dihydropteroate synthase
dihydrofolate synthase / folylpolyglutamate synthase
Cyclic pyranopterin monophosphate synthase
cyclic pyranopterin monophosphate synthase
molybdopterin synthase catalytic subunit
molybdopterin adenylyltransferase
molybdopterin molybdotransferase

molybdenum cofactor cytidylyltransferase
glutamyl-tRNA synthetase
glutamyl-tRNA reductase
glutamate-1-semialdehyde 2,1-aminomutase
porphobilinogen synthase (hemB)
hydroxymethylbilane synthase (hemC)
uroporphyrinogen-III synthase
uroporphyrinogen decarboxylase
oxygen-independent coproporphyrinogen III oxidase
protoporphyrinogen/coproporphyrinogen III oxidase
protoporphyrin/coproporphyrin ferrochelatase
hydrogen peroxide-dependent heme synthase
uroporphyrinogen III methyltransferase / synthase
precorrin-2 dehydrogenase / sirohydrochlorin ferrochelatase
Fe-coproporphyrin III synthase
sirohydrochlorin cobaltochelatase
precorrin-2/cobalt-factor-2 C20-methyltransferase
precorrin-3B C17-methyltransferase
cobalt-precorrin 5A hydrolase
precorrin-4/cobalt-precorrin-4 C11-methyltransferase
precorrin-6A/cobalt-precorrin-6A reductase
cobalt-precorrin-5B (C1)-methyltransferase
precorrin-6B C5,15-methyltransferase / cobalt-precorrin-6B C5,C15-methyltransferase
precorrin-8X/cobalt-precorrin-8 methylmutase
cobyrinic acid a,c-diamide synthase
cob(I)alamin adenosyltransferase
adenosylcobyric acid synthase
adenosylcobinamide kinase / adenosylcobinamide-phosphate guanylyltransferase
adenosylcobinamide-GDP ribazoletransferase
nicotinate-nucleotide--dimethylbenzimidazole phosphoribosyltransferase
1-deoxy-D-xylulose-5-phosphate reductoisomerase
2-C-methyl-D-erythritol 4-phosphate cytidylyltransferase
4-diphosphocytidyl-2-C-methyl-D-erythritol kinase
2-C-methyl-D-erythritol 2,4-cyclodiphosphate synthase
(E)-4-hydroxy-3-methylbut-2-enyl-diphosphate synthase
4-hydroxy-3-methylbut-2-enyl diphosphate reductase
4-hydroxy-3-methylbut-2-en-1-yl diphosphate reductase
4-hydroxy-3-methylbut-2-en-1-yl diphosphate reductase
4-hydroxy-3-methylbut-2-enyl diphosphate reductase
geranylgeranyl diphosphate synthase, type II
geranylgeranyl diphosphate synthase, type II
heptaprenyl diphosphate synthase
ferredoxin---nitrate reductase
carbonic anhydrase (cynT)
nitronate monooxygenase
phosphoadenosine phosphosulfate reductase
sulfite reductase (NADPH) flavoprotein alpha-component
sulfide:quinone oxidoreductase
cystathionine gamma-synthase ( metB)
homocysteine gamma-lyase

GMP synthase (glutamine-hydrolysing)
hypoxanthine phosphoribosyltransferase
O-acetylhomoserine (thiol)-lyase
N-acylneuraminate-9-phosphatase
N-acylneuraminate cytidylyltransferase
UDP-N-acetylglucosamine 4,6-dehydratase / 5-epimerase
phosphoglycolate phosphatase

S-(hydroxymethyl)glutathione dehydrogenase / alcohol dehydrogenase
saccharopine dehydrogenase (NAD+, L-lysine forming)
threonine-phosphate decarboxylase
5-aminopentanal:NAD+ 1-oxidoreductase
putrescine---pyruvate transaminase
carboxynorspermidine decarboxylase
L-phenylalanine/L-methionine N-acetyltransferase
amidase
thioredoxin reductase (NADPH) (trxB)
cysteine desulfurase / selenocysteine lyase
enicillin G amidase
ethanolamine ammonia-lyase large / small subunit
hydroxyacylglutathione hydrolase (gloB)
D-lactate dehydrogenase (cytochrome)(LDHD)
methylglyoxal/glyoxal reductase
malate dehydrogenase (oxaloacetate-decarboxylating, NADP+) (maeA)
methylglyoxal synthase
isocitrate lyase
glycine cleavage system H protein
oxalate decarboxylase(oxdD)
ethylmalonyl-CoA/methylmalonyl-CoA decarboxylase
nicotinate-nucleotide pyrophosphorylase (carboxylating)
cystathionine gamma-lyase / homocysteine desulfhydrase
catalase
polyphosphate kinase (ppk)
NAD(P)H-quinone oxidoreductase subunit 5 / NADH:ubiquinone reductase (H+-translocating)
cytochrome c oxidase subunit IV/III/II/I
cytochrome aa3-600 menaquinol oxidase subunit III/II/I
cytochrome bd ubiquinol oxidase subunit I/II
F-type H+/Na+-transporting ATPase subunit alpha/beta
manganese-dependent inorganic pyrophosphatase
sirohydrochlorin ferrochelatase
heme o synthase
acyl carrier protein
demethylmenaquinone methyltransferase / 2-methoxy-6-polyprenyl-1,4-benzoquinol methylase
tRNA dimethylallyltransferase
bifunctional isochorismate lyase / aryl carrier protein
2,3-dihydro-2,3-dihydroxybenzoate dehydrogenase
2,3-dihydroxybenzoate-AMP ligase
dihydroanticapsin dehydrogenase
L-alanine-L-anticapsin ligase
Succinate-semialdehyde dehydrogenase (acetylating)
hexadecanoyl-ACP:[acyl-carrier-protein] transferase
glycerophosphodiester phosphodiesterase (Glycerophosphoglycerol)
1 or 2-Diacyl-sn-glycerol 3-phosphate phosphohydrolase
cardiolipin synthase (cls)
digeranylgeranylglycerophospholipid reductase
GMP reductase(guaC)
bifunctional oligoribonuclease and PAP phosphatase NrnA
indole-3-glycerol-phosphate synthase (trpC)
ectoine hydrolase
(R)-citramalate synthase
ATP phosphoribosyltransferase regulatory subunit
N-acetyllactosaminide 3-alpha-galactosyltransferase
D-glycero-D-manno-heptose 1,7-bisphosphate phosphatase
UDP-2-acetamido-2,6-beta-L-arabino-hexul-4-ose reductase
penicillin-binding protein 4/2D
bifunctional autolysin

UDP-GlcNAc:undecaprenyl-phosphate/decaprenyl-phosphate GlcNAc-1-phosphate transferase
acetyl-CoA carboxylase biotin carboxyl carrier protein
aminomethyltransferase (gcvT)
glycine oxidase (thiO)
alkaline phosphatase D
farnesyl-diphosphate farnesyltransferase
4-nitrophenyl phosphatase
2-haloacid dehalogenase
undecaprenyl-phosphate N-acetylglucosaminyl 1-phosphate transferase
3-oxoacyl-[acyl-carrier-protein] synthase III
GTP diphosphokinase
superoxide dismutase
cysteine desulfurase
tryptophan---tRNA ligase
oxidoreductase
myo-inositol-phosphate phosphohydrolase
isoleucine---tRNA ligase
phosphopantothenoylcysteine decarboxylase
protein-serine/threonine phosphatase
non-specific serine/threonine protein kinase
methylenetetrahydrofolate---tRNA-(uracil54-C5)-methyltransferase
protein-glutamate methylesterase
protein-glutamine glutaminase
proline---tRNA ligase
polyribonucleotide nucleotidyltransferase
protein-glutamate O-methyltransferase
CCA tRNA nucleotidyltransferase
S-adenosylmethionine:tRNA ribosyltransferase-isomerase
histidine---tRNA ligase
aspartate---tRNA ligase
alanine---tRNA ligase
thioredoxin-dependent peroxiredoxin
glycine---tRNA ligase
methylenetetrahydrofolate dehydrogenase (NADP+)
Long-chain acyl-CoA synthetase
Aldehyde-alcohol dehydrogenase
NAD-dependent 3-hydroxybutyryl-CoA dehydrogenase
3-ketoacyl-CoA thiolase
(S)-3-hydroxybutyryl-CoA dehydrogenase
enoyl hydrase
trans-2-enoyl-CoA reductase
CoA-transferase
Short-chain fatty acids transporter
Spermidine ABC transport system
putrescine ABC transport system
Glycine betaine ABC transport system
L-proline ABC transport system
choline ABC transport system
Carnitine ABC transport system
Trimethylammonioacetate ABC transport system
adenosine ABC transport system
inosine ABC transport system
uridine ABC transport system
Deoxyguanosine ABC transport system
guanosine ABC transport system
cytidine ABC transport system
Deoxyuridine ABC transport system
Deoxyadenosine ABC transport system

Deoxycytidine ABC transport system
Xanthosine ABC transport system
Deoxyinosine ABC transport system
phosphate ABC transport system
L-Aspartate ABC transport system
L-Glutamate ABC transport system
L-glutamine ABC transport system
L-Cystine ABC transport system
L-Arginine ABC transport system
L-Lysine ABC transport system
L-histidine ABC transport system
L-valine ABC transport system
L-leucine ABC transport system
L-isoleucine ABC transport system
L-threonine ABC transport system
D-methionine ABC transport system
Oligopeptide ABC transport system
Nickel ABC transport system
Zinc ABC transport system
Cobalt ABC transport system
Biotin ABC transport system
Bacitracin ABC transport system
dipeptide transport via ABC system (ala-his)
transport of Na[e]
transport of MG[e]
transport of S[c]
transport of NA2SO4[c]
transport of AACID[e]
transport of ILE[e]
transport of AACID[e]
transport of VAL[e]
transport of PHE[e]
transport of LYS[e]
transport of K[e]
transport of CA2[e]
transport of BT[e]
transport of G[e]
transport of CA[e]
transport of FE2[e]
transport of FE3[e]
transport of OMP[e]
transport of SLF[e]
transport of UMP[e]
transport of URA[e]
transport of UREA[e]
exchange of acetate
exchange of ethanol
exchange of propanol
exchange of crotonate(e)
exchange of vinyl acetate
exchange of propionic acid
exchange of butanoic acid(e)
exchange of C5:0
exchange of C7:0
exchange of H2
exchange of carbon dioxide
exchange of hydrogencarbonate
exchange of L-alanine

exchange of L-arginine
exchange of L-asparagine
exchange of L-aspartic acid
exchange of L-cysteine
exchange of L-glutamine
exchange of L-glutamic acid
exchange of glycine
exchange of L-histidine
exchange of L-isoleucine
exchange of L-leucine
exchange of L-lysine
exchange of L-methionine
exchange of L-phenylalanine
exchange of L-proline
exchange of L-serine
exchange of L-threonine
exchange of L-tryptophan
exchange of L-tryptophan
exchange of L-valine
exchange of Fumarate
exchange of L-Phenylalanine
exchange of Urea
exchange of L-Glutamate
exchange of Orotidine 5'-phosphate
exchange of (R)-3-Hydroxybutanoate
exchange of (S)-Malate
exchange of O2
exchange of Oxaloacetate
exchange of 1,2-diacyl-sn-glycerol 3-phosphate
exchange of L-Serine
exchange of Succinate
exchange of UDP-glucose
exchange of Uracil
exchange of Uridine
exchange of hexanoic acid
exchange of oxalate
exchange of hydrogencarbonate
exchange of glycerol
exchange of D-mannitol
exchange of acetate
exchange of butyrate
exchange of L-Lactate(e)
exchange of D-Glucose(e)
exchange of Co2+
exchange of manganese
exchange of Ammonium
exchange of biotin
exchange of Calcium
exchange of Fe3+
exchange of Potassium
exchange of Sodium
exchange of Chloride
exchange of Dihydrogen phosphate
exchange of Hydrogen phosphate
exchange of Magnesium
exchange of Sulfate
exchange of water
phosphoribosylglycinamide formyltransferase 1

glutamate racemase
[acyl-carrier-protein] S-malonyltransferase (mdcH)
myristoyl-(acyl-carrier protein) synthesis
pentadecanoyl-(acyl-carrier protein) synthesis
hexadecanoyl-(acyl-carrier protein) synthesis
palmitoyl-(acyl-carrier protein) synthesis
heptadecanoyl-(acyl-carrier protein) synthesis
alcohol dehydrogenase (glycerol)
glycerol-3-phosphate O-acyltransferase
1-acylglycerol-3-phosphate O-acyltransferase
lysylphosphatidylglycerol synthesis
cardiolipin synthase
UDP-glucosyltransferase (monoglucosyl)monoglucosyldiacylglycerol synthase
UDP-glucosyltransferase (diglucosyl)
UDP-glucosyltransferase (triglucosyl)
2-enoate reductase FldZ
glycerol teichoic acid (n=45), unlinked, unsubstituted
glycerol teichoic acid (n=45), unlinked, D-ala substituted
glycerol teichoic acid (n=45), unlinked, glucose substituted
minor teichoic acid synthesis (n=30)
lipoteichoic acid synthesis (n=24) or  linked or  glucose substituted
lipoteichoic acid synthesis (n=24) or  linked or  N-acetylglucosamine substituted
lipoteichoic acid synthesis (n=24), unliked, D-alanine substituted
lipoteichoic acid synthesis (n=24) or  linked or  unsubstituted
lipoteichoic acid synthase(ltaS)
uridine kinase
ACP acetyltransferase
glycolaldehyde dehydrogenase
glyoxylate reductase
sink reaction of ACP
sink reaction of RFER
dihydrofolate reductase

Biotin carboxylase
2-oxoglutarate dehydrogenase E1 component
D-3-phosphoglycerate dehydrogenase(serA)
tetrahydrodipicolinate N-acetyltransferase
L-cysteinylglycine dipeptidase
phosphoribosyl-AMP cyclohydrolase
phosphopantothenoylcysteine decarboxylase
hypoxanthine phosphoribosyltransferase(hpt)
glucosamine-1-phosphate N-acetyltransferase
N-acetylmuramoyl-L-alanine amidase sle1
L-methionine R-oxide reductase (trdrd)
riboflavin kinase
homoserine O-acetyltransferase
dUTP pyrophosphatase
pimelyl-[acyl-carrier protein] methyl ester biosynthesis
BOF

Reaction
G6P[c] <=> G1P[c]
G6P[c] <=> F6P[c]
FDP[c] + H2O[c] -> F6P[c] + PI[c]
ATP[c] + F6P[c] -> ADP[c] + FDP[c] + H[c]
FDP[c] <=> T3P2[c] + T3P1[c]
T3P1[c] <=> T3P2[c]
T3P1[c] + NADP[c] + H2O[c] -> 3PG[c] + NADPH[c] + 2 H[c]
T3P1[c] + PI[c] + NAD[c] <=> 13PDG[c] + NADH[c] + H[c]
ADP[c] + 13PDG[c] <=> ATP[c] + 3PG[c]
2PG[c] <=> 3PG[c]
2PG[c] <=> PEP[c] + H2O[c]
PEP[c] + ADP[c] + H[c] -> PYR[c] + ATP[c]
NAD[c] + LLAC[c] <=> NADH[c] + PYR[c] + H[c]
COA[c] + NAD[c] + PYR[c] -> ACCOA[c] + CO2[c] + NADH[c]
ACAL[c] + THDP[c] <=> 2HYTHDIPH[c]
H2O[c] + NAD[c] + ACAL[c] -> NADH[c] + AC[c] + 2 H[c]
AC[c] + ATP[c] + COA[c] -> ACCOA[c] + ADP[c] + PI[c]
ATP[c] + PYR[c] + HCO3[c] -> ADP[c] + PI[c] + OA[c] + H[c]
H2O[c] + OA[c] + ACCOA[c] <=> H[c] + COA[c] + CIT[c]
CIT[c] <=> ICIT[c]
ICIT[c] + NAD[c] <=> CO2[c] + AKG[c] + NADH[c]
NAD[c] + COA[c] + AKG[c] -> NADH[c] + CO2[c] + SUCCOA[c]
ADP[c] + PI[c] + SUCCOA[c] <=> ATP[c] + COA[c] + SUCC[c]
AC[c] + SUCCOA[c] <=> SUCC[c] + ACCOA[c]
SUCC[c] + MQN8[c] -> FUM[c] + MQL8[c]
MAL[c] <=> FUM[c] + H2O[c]
MAL[c] + FAD[c] -> OA[c] + FADH2[c]
NAD[c] + MAL[c] <=> H[c] + NADH[c] + OA[c]
ATP[c] + OA[c] -> ADP[c] + PEP[c] + CO2[c]
FAD[e] + GLCNT[e] -> DGLCNT[e] + FADH2[e]
DGLCNT[c] + H[c] + NADPH[c] -> GLCNT[c] + NADP[c]
ATP[c] + GLCNT[c] -> ADP[c] + D6PGC[c] + H[c]
D6PGC[c] + NADP[c] -> RL5P[c] + CO2[c] + NADPH[c]
R5P[c] <=> RL5P[c]
R1P[c] <=> R5P[c]
ATP[c] + R5P[c] <=> H[c] + AMP[c] + PRPP[c]
ARAHE6P[c] <=> FALD[c] + RL5P[c]
F6P[c] <=> ARAHE6P[c]
T3P1[c] + S7P[c] <=> F6P[c] + E4P[c]
DR5P[c] <=> T3P1[c] + ACAL[c]
DR1P[c] <=> DR5P[c]
XUL5P[c] + E4P[c] <=> F6P[c] + T3P1[c]
R5P[c] + XUL5P[c] <=> T3P1[c] + S7P[c]
RL5P[c] <=> XUL5P[c]
MAN1P[c] + GTP[c] + H[c] <=> GDPMAN[c] + PPI[c]
GDP6DMAN[c] + NAD[c] <=> GDP4D6DMAN[c] + NADH[c] + H[c]
UDPG[c] <=> UDPGAL[c]
G1P[c] + H[c] + UTP[c] <=> UDPG[c] + PPI[c]
H[c] + 2 PYR[c] -> CO2[c] + ACLAC[c]
AACCOA[c] + NADPH[c] + H[c] <=> 3HBUTCOA[c] + NADP[c]
3HBUTCOA[c] <=> CROCOA[c] + H2O[c]
RFER[c] + NADH[c] + 2 NADP[c] + H[c] -> OFER[c] + NAD[c] + 2 NADPH[c]
ADP[c] + PI[c] + 4 H[e] -> H2O[c] + ATP[c] + 3 H[c]
RFER[c] + NAD[c] + 5 H[c] -> OFER[c] + NADH[c] + 4 H[e]
COA[c] + AACCOA[c] <=> 2 ACCOA[c]
ACTAC[c] + SUCCOA[c] <=> SUCC[c] + AACCOA[c]
NADH[c] + H[c] + ACTAC[c] <=> NAD[c] + HDBUT[c]

CHOR[c] <=> ICHOR[c]
ICHOR[c] + AKG[c] + H[c] -> SUCCYCA[c] + CO2[c]
SUCCYCA[c] -> SHCHC[c] + PYR[c]
SHCHC[c] -> H2O[c] + SUCBEN[c]
ATP[c] + SUCBEN[c] + COA[c] + H[c] -> AMP[c] + PPI[c] + SUCBENCO[c]
SUCBENCO[c] <=> DHNTCOA[c] + H2O[c]
DHNTCOA[c] + H2O[c] -> DHN[c] + COA[c] + H[c]
DHN[c] + OPP[c] + H[c] -> DMKH[c] + PPI[c] + CO2[c]
DMKH[c] + SAM[c] -> MQL8[c] + SAH[c] + H[c]
NADPH[c] + H[c] + MQN8[c] <=> NADP[c] + MQL8[c]
FRDP[c] + 5 IPP[c] -> 5 PPI[c] + OPP[c]
AKG[c] + ASP[c] <=> OA[c] + GLU[c]
ATP[c] + NH3[c] + GLU[c] -> ADP[c] + PI[c] + GLN[c] + H[c]
GLN[c] + H2O[c] -> GLU[c] + NH3[c]
H2O[c] + NAD[c] + GLU[c] -> NADH[c] + NH3[c] + AKG[c] + H[c]
F6P[c] + GLN[c] -> GLU[c] + GA6P[c]
ACCOA[c] + GLU[c] -> COA[c] + NAGLU[c] + H[c]
ATP[c] + NAGLU[c] -> ADP[c] + NAGLUP[c]
NAGLUS[c] + PI[c] + NADP[c] <=> NAGLUP[c] + NADPH[c] + H[c]
NAGLUS[c] + GLU[c] <=> NAORN[c] + AKG[c]
NAORN[c] + GLU[c] <=> ORN[c] + NAGLU[c]
CAP[c] + ORN[c] <=> PI[c] + CITR[c] + H[c]
ASP[c] + ATP[c] + CITR[c] -> 2 H[c] + AMP[c] + PPI[c] + ARGSUCC[c]
ARGSUCC[c] -> FUM[c] + ARG[c]
ARG[c] + H2O[c] -> ORN[c] + UREA[c]
UREA[c] + ATP[c] + HCO3[c] <=> ADP[c] + PI[c] + UREACAR[c]
UREACAR[c] + H2O[c] + 3 H[c] -> 2 NH3[c] + 2 CO2[c]
UREA[c] + H2O[c] -> CO2[c] + 2 NH3[c]
ADPR[c] + H2O[c] -> AMP[c] + 2 H[c] + R5P[c]
GLN[c] + PRPP[c] + H2O[c] + H[c] <=> PRAM[c] + PPI[c] + GLU[c]
ATP[c] + PRAM[c] + GLY[c] <=> ADP[c] + PI[c] + GAR[c] + H[c]
GAR[c] + METHF[c] + H2O[c] -> FGAR[c] + THF[c] + 2 H[c]
ATP[c] + H2O[c] + GLN[c] + FGAR[c] -> ADP[c] + H[c] + PI[c] + GLU[c] + FGAM[c]
ATP[c] + FGAM[c] -> ADP[c] + PI[c] + AIR[c] + H[c]
ATP[c] + AIR[c] + HCO3[c] <=> ADP[c] + PI[c] + N5CAIR[c]
N5CAIR[c] <=> CAIR[c]
ATP[c] + CAIR[c] + ASP[c] <=> ADP[c] + PI[c] + SAICAR[c] + H[c]
SAICAR[c] <=> FUM[c] + AICAR[c]
FTHF[c] + AICAR[c] -> THF[c] + PRFICA[c]
PRFICA[c] <=> H2O[c] + IMP[c]
ASP[c] + IMP[c] + GTP[c] -> 2 H[c] + PI[c] + GDP[c] + ASUC[c]
ASUC[c] -> FUM[c] + AMP[c]
ATP[c] + AMP[c] <=> 2 ADP[c]
ATP[c] + UDP[c] <=> ADP[c] + UTP[c]
ADP[c] + TRDRD[c] -> H2O[c] + DADP[c] + TRDOX[c]
ATP[c] + DADP[c] -> ADP[c] + DATP[c]
ATP[c] + GDP[c] -> ADP[c] + GTP[c]
ATP[c] + DAMP[c] <=> ADP[c] + DADP[c]
H2O[c] + DAMP[c] -> PI[c] + DA[c]
ATP[c] + DA[c] <=> AMP[c] + DAMP[c]
AMP[c] + PPI[c] <=> AD[c] + PRPP[c]
H2O[c] + IMP[c] -> PI[c] + INS[c] + H[c]
H2O[c] + AMP[c] -> PI[c] + ADN[c]
PI[c] + ADN[c] <=> R1P[c] + AD[c]
PI[c] + DA[c] <=> AD[c] + DR1P[c]
H2O[c] + H[c] + AD[c] -> NH3[c] + HYXN[c]
R1P[c] + HYXN[c] <=> PI[c] + INS[c]
H2O[c] + NAD[c] + IMP[c] -> H[c] + NADH[c] + XMP[c]

ATP[c] + XMP[c] + GLN[c] + H2O[c] <=> PPI[c] + GMP[c] + GLN[c]
ATP[c] + GMP[c] <=> ADP[c] + GDP[c]
GDP[c] + TRDRD[c] -> H2O[c] + DGDP[c] + TRDOX[c]
ATP[c] + DGDP[c] <=> ADP[c] + DGTP[c]
ADP[c] + DGDP[c] <=> ATP[c] + DGMP[c]
ATP[c] + DG[c] <=> ADP[c] + DGMP[c]
PI[c] + DG[c] <=> DR1P[c] + GN[c]
PRPP[c] + GN[c] -> PPI[c] + GMP[c]
R1P[c] + GN[c] <=> PI[c] + GSN[c]
H2O[c] + GMP[c] -> PI[c] + GSN[c]
H[c] + H2O[c] + GN[c] -> NH3[c] + XAN[c]
H2O[c] + NAD[c] + HYXN[c] -> H[c] + NADH[c] + XAN[c]
PI[c] + XTSINE[c] <=> R1P[c] + XAN[c]
H2O[c] + XMP[c] -> PI[c] + XTSINE[c]
H2O[c] + NAD[c] + XAN[c] -> H[c] + NADH[c] + URATE[c]
URATE[c] + O2[c] + 2 H2O[c] -> HIUR[c] + H2O2[c]
HIUR[c] + H2O[c] -> HYURCAR[c] + H[c]
HYURCAR[c] -> ALLOIN[c] + CO2[c]
H2O[c] + ALLOIN[c] <=> ATT[c]
H2O[c] + 2 H[c] + ATT[c] -> CO2[c] + NH3[c] + UR[c]
UR[c] + GLX[c] <=> GLY[c] + OXA[c]
ATT[c] + H2O[c] -> URG[c] + UREA[c]
2 H[c] + H2O[c] + UREA[c] -> CO2[c] + 2 NH3[c]
H2O[c] + 23CGMP[c] -> GU3P[c] + H[c]
GU3P[c] + H2O[c] -> GSN[c] + PI[c]
ATP[c] + H[c] + SLF[c] -> PPI[c] + APS[c]
ATP[c] + APS[c] -> ADP[c] + PAPS[c] + H[c]
ATP[c] + AIR[c] + HCO3[c] <=> ADP[c] + PI[c] + N5CAIR[c] + 2 H[c]
ATP[c] + DIDP[c] -> ADP[c] + DITP[c]
H2O[c] + DITP[c] -> H[c] + PPI[c] + DIMP[c]
XTP[c] + H2O[c] -> XMP[c] + PPI[c] + H[c]
2 ATP + GLN[c] + HCO3[c] + H2O[c] <=> 2 ADP[c] + PI[c] + CAP[c] + GLN[c]
CAP[c] + ASP[c] <=> PI[c] + CAASP[c]
H2O[c] + DOROA[c] <=> H[c] + CAASP[c]
DOROA[c] + NAD[c] <=> OROA[c] + NADH[c] + H[c]
PRPP[c] + OROA[c] <=> PPI[c] + OMP[c]
OMP[c] + H[c] -> UMP[c] + CO2[c]
H2O[c] + UMP[c] -> PI[c] + URI[c]
PI[c] + URI[c] <=> R1P[c] + URA[c]
DIHURA[c] + NAD[c] <=> H[c] + NADH[c] + URA[c]
H2O[c] + DIHURA[c] <=> H[c] + CAALA[c]
2 H[c] + H2O[c] + CAALA[c] -> CO2[c] + NH3[c] + bALA[c]
ATP[c] + URI[c] -> ADP[c] + UMP[c] + H[c]
ATP[c] + UMP[c] <=> ADP[c] + UDP[c]
ATP[c] + UTP[c] + NH3[c] -> ADP[c] + PI[c] + CTP[c] + 2 H[c]
H[c] + CTP[c] + H2O[c] -> UTP[c] + NH3[c]
ADP[c] + CTP[c] <=> ATP[c] + CDP[c]
ATP[c] + CMP[c] <=> ADP[c] + CDP[c]
H2O[c] + CMP[c] -> PI[c] + CYTD[c]
H[c] + H2O[c] + CYTD[c] -> NH3[c] + URI[c]
H[c] + H2O[c] + CYTS[c] -> NH3[c] + URA[c]
CYTS[c] + R1P[c] -> CYTD[c] + PI[c]
TRDRD[c] + CTP[c] -> DCTP[c] + TRDOX[c] + H2O[c]
ATP[c] + DCDP[c] <=> ADP[c] + DCTP[c]
DCDP[c] + H2O[c] <=> DCMP[c] + PI[c] + 2 H[c]
ATP[c] + DCMP[c] -> ADP[c] + DCDP[c]
ATP[c] + DC[c] -> ADP[c] + DCMP[c]
H2O[c] + DCMP[c] -> PI[c] + DC[c]

H[c] + H2O[c] + DC[c] -> NH3[c] + DU[c]
PI[c] + DU[c] <=> DR1P[c] + URA[c]
H[c] + H2O[c] + DCTP[c] -> NH3[c] + DUTP[c]
ATP[c] + DUDP[c] <=> ADP[c] + DUTP[c]
UDP[c] + TRDRD[c] -> H2O[c] + TRDOX[c] + DUDP[c]
ATP[c] + DUMP[c] <=> ADP[c] + DUDP[c]
ATP[c] + DU[c] -> ADP[c] + H[c] + DUMP[c]
H2O[c] + DUMP[c] -> PI[c] + DU[c]
DUMP[c] + METTHF[c] <=> DHF[c] + DTMP[c]
ATP[c] + DTMP[c] <=> ADP[c] + DTDP[c]
ATP[c] + DTDP[c] <=> ADP[c] + DTTP[c]
H2O[c] + DTMP[c] -> PI[c] + DT[c]
DR1P[c] + THY[c] <=> PI[c] + DT[c]
DIHYM[c] + NAD[c] <=> THY[c] + NADH[c] + H[c]
DIHYM[c] + H2O[c] <=> 3UREB[c]
3UREB[c] + H2O[c] <=> 3A2MP[c] + CO2[c] + NH3[c]
ALA[c] + NAD[c] + H2O[c] <=> PYR[c] + NH3[c] + NADH[c] + H[c]
ATP[c] + ASP[c] + NH3[c] -> AMP[c] + PPI[c] + ASN[c] + H[c]
ASN[c] + H2O[c] -> NH3[c] + ASP[c]
H2O[c] + O2[c] + ASP[c] -> OA[c] + NH3[c] + H2O2[c]
ASP[c] + OACID[c] <=> 2 OSUC[c] + AACID[c]
MOD[c] + H2O[c] <=> CAR[c] + NH3[c]
ASP[c] <=> DASP[c]
ASP[c] + H2O[c] + O2[c] -> OA[c] + NH3[c] + H2O2[c]
ATP[c] + ASP[c] + CITR[c] -> H[c] + PPI[c] + AMP[c] + ARGSUCC[c]
OGLU[c] + H2O[c] <=> AKG[c] + NH3[c]
GLN[c] + AKG[c] + NADPH[c] + H[c] -> 2 GLU[c] + NADP[c]
ATP[c] + NH3[c] + GLU[c] -> ADP[c] + H[c] + PI[c] + GLN[c]
F6P[c] + GLN[c] -> GA6P[c] + GLU[c]
2 ATP[c] + H2O[c] + GLN[c] + HCO3[c] -> 2 ADP[c] + 2 H[c] + PI[c] + GLU[c] + CAP[c]
P5C[c] + NADP[c] + 2 H2O[c] -> GLU[c] + NADPH[c] + H[c]
GLU[c] + H[c] -> CO2[c] + GABA[c]
AKG[c] + GABA[c] <=> GLU[c] + SUCCSAL[c]
H2O[c] + NADP[c] + SUCCSAL[c] -> SUCC[c] + NADPH[c] + 2 H[c]
H[c] + NADH[c] + HPYR[c] -> NAD[c] + G[c]
ATP[c] + G[c] -> ADP[c] + 2PG[c] + H[c]
3PG[c] + NAD[c] <=> PHP[c] + NADH[c] + H[c]
GLU[c] + PHP[c] <=> AKG[c] + 3PSER[c]
3PSER[c] + H2O[c] -> SER[c] + PI[c]
SER[c] -> NH3[c] + PYR[c]
DSER[c] <=> NH3[c] + PYR[c]
SER[c] -> DSER[c]
SER[c] + IGP[c] -> H2O[c] + T3P1[c] + TRP[c]
SER[c] + THF[c] <=> H2O[c] + GLY[c] + METTHF[c]
GLY[c] + LIPOYLPROTEIN[c] -> CO2[c] + SAP[c]
SAP[c] + THF[c] -> DIHYDROLIPOYLPROTEIN[c] + METTHF[c] + NH3[c]
NAD[c] + DIHYDROLIPOYLPROTEIN[c] -> H[c] + NADH[c] + LIPOYLPROTEIN[c]
ACCOA[c] + GLY[c] <=> COA[c] + AOBUT[c]
RCH[c] + H2O[c] + O2[c] <=> ALD[c] + NH3[c] + H2O2[c]
THR[c] <=> GLY[c] + ACAL[c]
THR[c] -> NH3[c] + OBUT[c]
ATP[c] + ASP[c] -> ADP[c] + BASP[c]
H[c] + NADPH[c] + BASP[c] -> PI[c] + NADP[c] + ASPSA[c]
PYR[c] + ASPSA[c] -> HTPA[c] + H2O[c] + H[c]
HTPA[c] + NADPH[c] + H[c] -> TDHDP[c] + NADP[c] + H2O[c]
NADPH[c] + H[c] + ASPSA[c] -> NADP[c] + HSER[c]
H[c] + NADH[c] + ASPSA[c] -> NAD[c] + HSER[c]
ATP[c] + HSER[c] -> ADP[c] + PHSER[c] + H[c]

PHSER[c] + H2O[c] -> THR[c] + PI[c]
CDPDG[c] + SER[c] -> CMP[c] + PS[c]
SER[c] + HCYS[c] -> CYTHNE[c] + H2O[c]
H2O[c] + CYTHNE[c] -> NH3[c] + CYS[c] + OBUT[c]
3PSER[c] + THJ[c] <=> SULCYS[c] + PI[c]
ASER[c] + H2S[c] -> CYS[c] + AC[c] + H[c]
ASER[c] + THJ[c] <=> SULCYS[c] + AC[c]
ACCOA[c] + SER[c] <=> COA[c] + ASER[c]
SER[c] -> AMACR[c] + H2O[c]
H2S[c] + ASER[c] -> H[c] + AC[c] + CYS[c]
CYS[c] + SLF[c] + H[c] -> CYSTE[c] + H2S[c]
AKG[c] + CYS[c] <=> GLU[c] + MPYR[c]
SULLTE[c] + NAD[c] <=> SPYR[c] + NADH[c] + H[c]
SULLTE[c] <=> PYR[c] + HSO3[c]
MERCPPYR[c] + NADH[c] + H[c] -> MERLAC[c] + NAD[c]
MERCPPYR[c] + H2SO3[c] -> TSUL[c] + PYR[c]
SULALA[c] + AKG[c] <=> SPYR[c] + GLU[c]
ASP[c] + H[c] -> ALA[c] + CO2[c]
LCYSSCON[c] + H2O[c] <=> HIO[c] + NH3[c] + PYR[c]
HCYS[c] + MTHF[c] -> H[c] + THF[c] + MET[c]
MET[c] + TRDRD[c] + H2O[c] <=> METOX[c] + TRDOX[c]
GLN[c] + METOBU[c] <=> OXOG[c] + MET[c]
PI[c] + PPI[c] + SAM[c] <=> MET[c] + ATP[c] + H2O[c]
SAM[c] <=> SAH[c]
SAH[c] + H2O[c] <=> RHCYS[c] + AD[c]
RHCYS[c] -> DIHY23DIO[c] + HCYS[c]
ASER[c] + HCYS[c] -> CYS[c] + AC[c] + H[c]
SUCCOA[c] + HSER[c] -> COA[c] + OSLHSER[c]
OSLHSER[c] + H2O[c] -> OBUT[c] + SUCC[c] + NH3[c] + H[c]
CYTHNE[c] + SUCC[c] + H[c] -> OSLHSER[c] + CYS[c]
NADH[c] + NH3[c] + H[c] + 3MOP[c] <=> H2O[c] + NAD[c] + ILE[c]
LAC[c] + 2 FERI[c] <=> PYR[c] + 2 FERO[c] + 2 H[c]
OMVAL[c] + LIPOE[c] <=> DRS2MET[c] + H2O[c]
DIHYDROLIPOYLPROTEIN[c] + NAD[c] -> LIPOYLPROTEIN[c] + NADH[c] + H[c]
LF1PHO[c] <=> T3P2[c] + LACAL[c]
3MBUTCOA[c] + FAD[c] -> MECRCO[c] + FADH2[c]
H2O[c] + MCRCOA[c] <=> HMBUTCOA[c]
H3MCOA[c] <=> METGCOA[c] + H2O[c]
H3MCOA[c] <=> ACCOA[c] + ACTAC[c]
H2O[c] + HIBUTCOA[c] -> HYISORATE[c] + COA[c] + H[c]
GLU[c] + OMVAL[c] <=> AKG[c] + VAL[c]
M1HYPT[c] + LIPOE[c] <=> DRS2MET[c] + THDP[c]
DLIPO[c] + NAD[c] <=> LIPOE[c] + NADH[c] + H[c]
MCOA[c] + DLIPO[c] <=> DRS2MET[c] + COA[c]
2 IBCOA[c] + O2[c] -> 2 MEENCOA[c] + 2 H2O
H2O[c] + MEENCOA[c] <=> HIBUTCOA[c]
3MOP[c] + THDP[c] <=> M1HYBT[c] + CO2[c]
M1HYBT[c] + LIPOE[c] <=> DIPT2BDPL[c] + THDP[c]
MBCOA[c] + DLIPO[c] <=> DIPT2BDPL[c] + COA[c]
MBCOA[c] <=> MCRCOA[c]
H2O[c] + MCRCOA[c] <=> 2S3SMETCOA[c]
2S3SMETCOA[c] + NAD[c] <=> MCECOA[c] + NADH[c] + H[c]
COA[c] + MCECOA[c] <=> PROPCOA[c] + ACCOA[c]
ATP[c] + PROPCOA[c] + HCO3[c] -> ADP[c] + PI[c] + MMCOA[c] + H[c]
MMCOA[c] <=> RMMCOA[c]
MMCOAR[c] <=> SUCCOA[c]
HYISORATE[c] + NAD[c] <=> SMESEMDE[c] + NADH[c] + H[c]
SMESEMDE[c] + GLU[c] <=> AMISO[c] + AKG[c]

SMESEMDE[c] + NAD[c] + H2O[c] -> MMALN[c] + NADH[c] + 2 H[c]
R2MMAL[c] -> MEMA[c] + H2O[c]
MEMA[c] + H2O[c] -> ERY3MEM[c]
ERY3MEM[c] + NAD[c] -> OBUT[c] + NADH[c] + CO2[c] + H[c]
THR[c] -> OBUT[c] + NH3[c]
ABUT[c] <=> HMOP[c]
H[c] + NADPH[c] + HMOP[c] <=> NADP[c] + DHMP[c]
DHMP[c] -> H2O[c] + 3MOP[c]
GLU[c] + 3MOP[c] -> AKG[c] + ILE[c]
H[c] + PYR[c] + OBUT[c] -> CO2[c] + ABUT[c]
ACLAC[c] <=> 33HMEOXOBUT[c]
H[c] + NADPH[c] + 33HMEOXOBUT[c] <=> NADP[c] + DH3MVA[c]
DH3MVA[c] -> OMVAL[c] + H2O[c]
2 PYR[c] + H[c] -> ACLAC[c] + CO2[c]
ACCOA[c] + OMVAL[c] + H2O[c] -> IPPMAL[c] + COA[c] + H[c]
IPPMAL[c] <=> CBHCAP[c]
NAD[c] + CBHCAP[c] -> NADH[c] + H[c] + OICAP[c]
H[c] + OICAP[c] -> CO2[c] + 4MOP[c]
GLU[c] + 4MOP[c] <=> AKG[c] + LEU[c]
SUCCOA[c] + TDHDP[c] + H2O[c] <=> NSUCLOXO[c] + COA[c]
H2O[c] + SUCCOA[c] + TDHDP[c] -> COA[c] + SAOPIM[c]
GLU[c] + SAOPIM[c] -> AKG[c] + SDAPIM[c]
H2O[c] + SDAPIM[c] -> DAPIM[c] + SUCC[c]
DAPIM[c] <=> MDAPIM[c]
H[c] + MDAPIM[c] -> CO2[c] + LYS[c]
ATP[c] + UDPNAMAG[c] + MDAPIM[c] -> ADP[c] + PI[c] + UGMD[c] + H[c]
ATP[c] + UGMD[c] + ALAALA[c] -> ADP[c] + PI[c] + UGMDA[c] + H[c]
AL26DA[c] + H2O[c] <=> AC[c] + DAPIM[c]
LYS[c] + O2[c] <=> 5AMD[c] + CO2[c] + H2O[c]
5AMD[c] + H2O[c] <=> 5APTA[c] + NH3[c]
5APTA[c] + AKG[c] <=> GLU[c] + GSALD[c]
PTAT[c] + NAD[c] + H2O[c] <=> GTAT[c] + NADH[c] + H[c]
ATP[c] + GTAT[c] + COA[c] -> ADP[c] + PI[c] + GLTCOA[c]
GLTCOA[c] + ETFLA[c] <=> CRONYLCOA[c] + CO2[c] + RETFLA[c]
H2O[c] + CRONYLCOA[c] <=> 3HBCOA[c]
ATP[c] + GLU[c] -> ADP[c] + GLU5P[c]
GLU5P[c] + NADPH[c] + H[c] -> P5C[c] + PI[c] + NADP[c]
AKG[c] + ORN[c] -> GLU[c] + GLUGSAL[c]
ACCOA[c] + GLUS[c] <=> COA[c] + NAGLUS[c]
ORN[c] -> PRO[c] + NH3[c]
NADH[c] + 2 H[c] + P5C[c] -> NAD[c] + PRO[c]
NADPH[c] + 2 H[c] + P5C[c] -> NADP[c] + PRO[c]
PRO[c] + AKG[c] + O2[c] -> HPRO[c] + SUCC[c] + CO2[c]
HPRO[c] + QUI[c] <=> PHC[c] + QIL[c]
FAD[c] + PRO[c] -> FADH2[c] + P5C[c] + H[c]
PHC[c] + NAD[c] + 2 H2O[c] -> E4HGLU[c] + NADH[c] + H[c]
AKG[c] + E4HGLU[c] -> GLU[c] + HYDROXYAKG[c]
HYDROXYAKG[c] -> PYR[c] + GLX[c]
ARG[c] + H[c] -> CO2[c] + AGMT[c]
UREA[c] + PTRSC[c] <=> H2O[c] + AGMT[c]
PTRSC[c] + AKG[c] -> ABAL[c] + GLU[c]
ABAL[c] + H2O[c] + NAD[c] <=> GABA[c] + NADH[c] + 2 H[c]
SPRM[c] + H2O[c] + O2[c] <=> SPRMD[c] + 3APTAL[c] + H2O2[c]
PPI[c] + PRBATP[c] <=> ATP[c] + PRPP[c]
H2O[c] + PRBATP[c] -> H[c] + PPI[c] + PRBAMP[c]
PRBAMP[c] + H2O[c] <=> PRFP[c]
PRFP[c] <=> PRLP[c]
GLN[c] + PRLP[c] -> GLU[c] + H[c] + DIMGP[c] + AICAR[c]

DIMGP[c] <=> IMACP[c] + H2O[c]
GLU[c] + IMACP[c] <=> AKG[c] + HISOLP[c]
HISOLP[c] + H2O[c] <=> HISOL[c] + PI[c]
NAD[c] + HISOL[c] -> H[c] + NADH[c] + HISTIDINAL[c]
H2O[c] + NAD[c] + HISTIDINAL[c] -> 2 H[c] + NADH[c] + HIS[c]
GLU[c] + 4HPP[c] <=> AKG[c] + TYR[c]
4HPP[c] <=> 4HYDPDE[c] + CO2[c]
TRM[c] + H2O[c] + O2[c] <=> 4HYDPDE[c] + NH3[c] + H2O2[c]
4HYDPDE[c] + NAD[c] + H2O[c] <=> HPA[c] + NADH[c] + H[c]
HPA[c] + O2[c] + NADH[c] + H[c] <=> DIH[c] + NAD[c] + H2O[c]
GLU[c] + PHPYR[c] <=> AKG[c] + PHE[c]
PHPYR[c] + H[c] -> PHACAL[c] + CO2[c]
PHACAL[c] + NAD[c] + H2O[c] -> PHAC[c] + NADH[c] + 2 H[c]
ATP[c] + PAC[e] + COA[c] <=> AMP[c] + PPI[c] + PHECOA[c]
OXODC[c] + COA[c] <=> C2PCOA[c] + AACCOA[c]
C2PCOA[c] + H2O[c] <=> 3HDCOA[c]
AACCOA[c] + NADPH[c] + H[c] -> 3HBCOA[c] + NADP[c]
COA[c] + 3OACOA[c] -> ACCOA[c] + SUCCOA[c]
PEP[c] + E4P[c] + H2O[c] <=> 3 DDAH7P[c] + PI[c]
3 DDAH7P[c] -> PI[c] + DQT[c]
DQT[c] <=> H2O[c] + DHSK[c]
H[c] + NADPH[c] + DHSK[c] <=> NADP[c] + SME[c]
ATP[c] + SME[c] -> ADP[c] + H[c] + SME3P[c]
PEP[c] + SME3P[c] <=> PI[c] + 3PSME[c]
3PSME[c] -> PI[c] + CHOR[c]
GLN[c] + CHOR[c] -> PYR[c] + GLU[c] + H[c] + AN[c]
PRPP[c] + AN[c] -> PPI[c] + NPRAN[c]
NPRAN[c] -> CPAD5P[c]
H[c] + CPAD5P[c] -> H2O[c] + CO2[c] + IGP[c]
IGP[c] <=> T3P1[c] + IND[c]
SER[c] + IND[c] <=> H2O[c] + TRP[c]
CHOR[c] -> PHEN[c]
H[c] + PHEN[c] -> H2O[c] + CO2[c] + PHPYR[c]
NAD[c] + PHEN[c] -> NADH[c] + CO2[c] + 4HPP[c]
ASP[c] + PHEN[c] -> OA[c] + AG[c]
H[c] + AG[c] -> H2O[c] + CO2[c] + PHE[c]
ASP[c] + H[c] -> bALA[c] + CO2[c]
CYSTE[c] + H[c] -> TAUR[c] + CO2[c]
LGLUP[c] + AACID[c] <=> PEP[c] + LGLUAMA[c]
HYP[c] + NAD[c] + H2O[c] -> TAUR[c] + NADH[c] + H[c]
SELNT[c] + ATP[c] + 2 H[c] -> ASELNT[c] + PPI[c]
SELT[c] + H2O[c] <=> SELNT[c]
SELT[c] + 3 NADPH[c] + 4 H[c] -> SELD[c] + 3 NADP[c] + 3 H2O[c]
ATP[c] + MET[c] + MTRNA[c] <=> AMP[c] + PPI[c] + LMETTRNA[c]
SELD[c] + ALA[c] + FAD[c] + H[c] <=> SCYS[c] + FADH2[c]
OSLHSER[c] + SCYS[c] -> SCYST[c] + SUCC[c] + H[c]
SCYST[c] + H2O[c] -> SHSYS[c] + NH3[c] + PYR[c] + 2 H[c]
SHSYS[c] + METLGLU[c] <=> SLSYS[c] + TETLGLU[c]
CYAL[c] + 2 H2O[c] -> ASP[c] + NH3[c]
AMPROTR[c] + GLU[c] -> GAPPN[c] + H2O[c]
CYAL[c] + GLU[c] <=> GCALA[c] + H2O[c]
DGLN[c] + H2O[c] -> DGLU[c] + NH3[c]
ATP[c] + DGLU[c] + UDPNAMA[c] <=> UDPNAMAG[c] + ADP[c] + PI[c]
ALA[c] <=> DALA[c]
ATP[c] + 2 DALA[c] <=> ALAALA[c] + ADP[c] + PI[c]
ATP[c] + OXOP[c] + 2 H2O[c] <=> ADP[c] + PI[c] + GLU[c]
GSH[c] + H2O[c] -> GLYCYS[c] + GLU[c]
H2O[c] + CGLY[c] -> GLY[c] + CYS[c]

2 RGT[c] + H2O2[c] -> OGT[c] + 2 H2O[c]
NADP[c] + 2 RGT[c] <=> NADPH[c] + H[c] + OGT[c]
RX[c] + RGT[e] <=> HAL[c] + RSG[c]
RSG[c] + H2O[c] <=> RSC[c] + GLU[c]
RSC[c] + H2O[c] <=> SSLC[c] + GLY[c]
AACCOA[c] + SSLC[c] <=> SSNALC[c] + COA[c]
CYC[e] + H2O[e] <=> MEL[e]
MEL[c] + H2O[c] <=> MLT[c]
STAR[c] <=> CYC[c]
PAPS[c] + HSGLU[c] <=> PAP[c] + HSNSGLU[c]
GA6P[c] <=> GA1P[c]
ACCOA[c] + GA1P[c] -> H[c] + COA[c] + NAGA1P[c]
H[c] + UTP[c] + NAGA1P[c] -> PPI[c] + UDPNAG[c]
UDPNAG[c] <=> UDPNAGA[c]
PEP[c] + UDPNAG[c] -> PI[c] + UACCG[c]
UACCG[c] + NADPH[c] + H[c] -> NADP[c] + UDPNAM[c]
UDPNAG[c] -> UACMAM[c]
UACMAM[c] + 2 NAD[c] + H2O[c] <=> UACMAMU[c] + 2 NADH[c] + 2 H[c]
MET[c] + H2O[c] -> METH[c] + NH3[c] + OBUT[c]
G1P[c] + DTTP[c] + H[c] -> PPI[c] + DTDPGLC[c]
DTDPGLC[c] <=> H2O[c] + DTDPDDG[c]
H2O[c] + MI4P[c] -> PI[c] + MYOI[c]
bDG6P[c] -> MI3P[c]
ATP[c] + UDPNAM[c] + ALA[c] <=> PI[c] + ADP[c] + UDPNAMA[c]
ATP[c] + UDPNAMAG[c] + LYS[c] -> ADP[c] + PI[c] + UDPNADMLADGLULYS[c] + H[c]
ATP[c] + UDPNADMLADGLULYS[c] <=> ADP[c] + PI[c] + UGGLA[c]
UGMDA[c] + UDCPP[c] -> UMP[c] + UAGMDA[c]
UDPNAG[c] + UAGMDA[c] -> H[c] + UDP[c] + UAAGMDA[c]
DPUDCP[c] + ATP[c] -> UDCPP[c] + ADP[c] + H[c]
UDCPDP[c] + H2O[c] -> UDCPP[c] + PI[c] + H[c]
FRDP[c] + 8 IPP[c] <=> 8 PPI[c] + UDCPDP[c]
UAAGMDA[c] -> H[c] + PEPG[c] + UDCPDP[c]
H2O[c] + NAD[c] + GLYAL[c] <=> 2 H[c] + NADH[c] + G[c]
GL[c] + NADP[c] <=> GLYAL[c] + NADH[c] + H[c]
ATP[c] + GL[c] -> ADP[c] + GL3P[c] + H[c]
APHO[c] + GL3P[c] <=> AGL3P[c] + PI[c]
ACYLACP[c] + PI[c] <=> APHO[c] + ACACP[c]
DAGL[c] + ATP[c] -> PA[c] + ADP[c] + H[c]
GL3P[c] + NADP[c] <=> T3P2[c] + NADPH[c] + H[c]
H2O[c] + MI1P[c] -> PI[c] + MYOI[c]
PE[c] + H2O[c] -> DAGL[c] + EP[c]
FAD[c] + GL3P[c] -> T3P2[c] + FADH2[c]
CTP[c] + GL3P[c] + H[c] -> CDPGL[c] + PPI[c]
CTP[c] + PA[c] + H[c] -> PPI[c] + CDPDG[c]
CDPDG[c] + GL3P[c] -> CMP[c] + PGP[c]
PGP[c] + H2O[c] -> PG[c] + PI[c]
H[c] + PS[c] -> CO2[c] + PE[c]
PL[c] + H2O[c] -> ACYPL[c] + CAR[c]
AG3PC[c] + 100 H2O[c] -> 100 FA[c] + G3PC[c]
H2O[c] + GLYCEROCHO[c] -> GL3P[c] + CHO[c] + H[c]
GLYCEROPE[c] + H2O[c] -> ETHAM[c] + GL3P[c] + H[c]
ATP[c] + ACCOA[c] + HCO3[c] -> ADP[c] + PI[c] + MALCOA[c]
H2O[c] + ACCOA[c] + GLX[c] -> MAL[c] + COA[c] + H[c]
ATP[c] + COA[c] + AC[c] -> PPI[c] + AMP[c] + ACCOA[c]
PYR[c] + Q8[c] + H2O[c] -> CO2[c] + AC[c] + Q8H2[c]
HYD[c] <=> GOXA[c]
2H5MCMSHD[c] + NAD[c] + H2O[c] <=> NADH[c] + H[c] + 2H5MCMT[c]
CCL[c] + O2[c] <=> 2 HYD6SEM[c]

RTA[c] <=> H2O[c] + OA[c]
MTART[c] + NAD[c] <=> HYDOXO[c] + NADH[c] + H[c]
PRPECO[c] + H2O[c] <=> HPCOA[c]
BACOA[c] <=> PRPECO[c] + NH3[c]
BALA[c] + AKG[c] -> 3OXPRPA[c] + GLU[c]
ETRF[c] + PROPCOA[c] <=> RETF[c] + PRPECO[c]
PROPCOA[c] + DLIPO[c] <=> ENPLYS[c] + COA[c]
2HTHDP[c] + LIPOE[c] <=> THDP[c] + ENPLYS[c]
OBUT[c] + THDP[c] <=> 2HTHDP[c] + CO2[c]
HBUT[c] + NAD[c] -> OBUT[c] + H[c] + NADH[c]
2MICIT[c] <=> SUCC[c] + PYR[c]
3 HYDTRI[c] <=> 2 ENETRI[c] + H2O[c]
2MCIT[c] <=> BTRI[c] + H2O[c]
PROPCOA[c] + OA[c] + H2O[c] <=> HYDTRI[c] + COA[c]
PYR[c] + MMCOA[c] <=> OA[c] + PROPCOA[c]
QUI[c] + SUCC[c] <=> HQE[c] + FUM[c]
C40COA[c] + AC[c] <=> BUAC[c] + ACCOA[c]
C40COA[c] + NADP[c] <=> CRONYLCOA[c] + NADPH[c] + H[c]
NAD[c] + 3HBCOA[c] <=> NADH[c] + H[c] + AACCOA[c]
2 RFER[c] + AACOA[c] + 2 H[c] + CO2[c] <=> OFER[c] + PYR[c] + COA[c]
NADP[c] + DHF[c] <=> NADPH[c] + H[c] + FOL[c]
ATP[c] + FOR[c] + THF[c] -> ADP[c] + PI[c] + FTHF[c]
H2O[c] + FTHF[c] <=> H[c] + THF[c] + FOR[c]
H[c] + FTHF[c] <=> H2O[c] + METHF[c]
LMETTRNA[c] + FTHF[c] <=> THF[c] + NFORTRNA[c]
ATP[c] + 5FTHF[c] -> ADP[c] + PI[c] + METHF[c]
NADPH[c] + H[c] + METTHF[c] -> NADP[c] + MTHF[c]
CIT[c] <=> CACT[c] + H2O[c]
SUCCOA[c] + 2 RFER[c] + CO2[c] + H[c] -> AKG[c] + COA[c] + 2 OFER[c]
AIR[c] + SAM[c] -> AHMP[c] + DAD5[c] + MET[c] + FOR[c] + CO[c] + 3 H[c]
ATP[c] + AHM[c] -> ADP[c] + AHMP[c] + H[c]
ATP[c] + AHMP[c] -> ADP[c] + 2MAHMP[c]
2 H[c] + 4MPETZ[c] + 2MAHMP[c] -> PPI[c] + THMP[c]
THMP[c] + H2O[c] <=> THME[c] + PI[c]
ATP[c] + THME[c] -> AMP[c] + THDP[c] + H[c]
THDP[c] + ADP[c] <=> THTP[c] + AMP[c]
SULCP[c] + ATP[c] <=> ASCP[c] + PPI[c]
ESSUL[c] + ASCP[c] <=> AMP[c] + TSCP[c] + ECYS[c]
PYR[c] + T3P1[c] + H[c] -> DX5P[c] + CO2[c]
DX5P[c] + IMGLY[c] + THISULCP[c] <=> CMYPHO[c] + SULCP[c] + 2 H2O[c]
CMYPHO[c] <=> CMEPHO[c]
AHMDP[c] + CMEPHO[c] <=> THMP[c] + PPI[c] + CO2[c]
ATP[c] + THZ[c] -> ADP[c] + THZP[c] + H[c]
H2O[c] + THME[c] -> H[c] + AHM[c] + THZ[c]
RL5P[c] -> H[c] + FOR[c] + DB4P[c]
3 H2O[c] + GTP[c] -> 2 H[c] + PPI[c] + D6RP5P[c] + FOR[c]
H[c] + H2O[c] + D6RP5P[c] -> NH3[c] + A6RP5P[c]
H[c] + NADPH[c] + A6RP5P[c] -> NADP[c] + A6RP5P2[c]
APDRU[c] + H2O[c] <=> ADRU[c] + PI[c]
4R5AU[c] + DB4P[c] -> D8RL[c] + 2 H2O[c] + PI[c] + H[c]
2 D8RL[c] + 2 H[c] -> 4R5AU[c] + RIBFLAV[c]
ATP[c] + RIBFLAV[c] -> ADP[c] + FMN[c] + H[c]
ATP[c] + H[c] + FMN[c] -> FAD[c] + PPI[c]
NADPH[c] + FMN[c] + H[c] -> NADP[c] + FMNH2[c]
FMNH2[c] + O2[c] <=> DIMBEN[c] + E4P[c] + H2O[c]
PDXAM[c] + ATP[c] -> ADP[c] + PDXAM5PI[c] + H[c]
H2O[c] + O2[c] + PDXAM5PI[c] -> H2O2[c] + NH3[c] + PDXL5PI[c]
PDXAL[c] + ATP[c] -> ADP[c] + PDXL5PI[c] + H[c]

R5P[c] + T3P1[c] + GLN[c] <=> PDXL5PI[e] + GLN[c] + 3 H2O[c] + PI[c]
H2O[c] + PHT[c] <=> PI[c] + 4HLT[c]
PDXI[c] + ATP[c] -> ADP[c] + P5P[c] + H[c]
O2[c] + P5P[c] -> H2O2[c] + PDXL5PI[c]
ASP[c] + NAD[c] -> 2 H[c] + IMASP[c] + NADH[c]
ASP[c] + NADP[c] -> 2 H[c] + IMASP[c] + NADPH[c]
O2[c] + ASP[c] -> H2O2[c] + H[c] + IMASP[c]
T3P2[c] + IMASP[c] -> 2 H2O[c] + PI[c] + PYR2CAR[c]
3 H[c] + PRPP[c] + PYR2CAR[c] -> CO2[c] + PPI[c] + NAMN[c]
NICA[c] + PRPP[c] + ATP[c] + H2O[c] + H[c] <=> NAMN[c] + ADP[c] + PPI[c] + PI[c]
H2O[c] + NAMN[c] -> PI[c] + NAR[c]
PI[c] + NAR[c] <=> H[c] + R1P[c] + NICA[c]
NAMN[c] + ATP[c] <=> DP[c] + DNAD[c]
ATP[c] + NH3[c] + DNAD[c] -> NAD[c] + PPI[c] + AMP[c] + H[c]
ATP[c] + NAD[c] -> ADP[c] + NADP[c] + H[c]
ATP[c] + H[c] + NMN[c] <=> NAD[c] + PPI[c]
NMN[c] + H2O[c] <=> NAMN[c] + NH3[c]
PI[c] + NAMD[c] <=> H[c] + R1P[c] + NICD[c]
H2O[c] + NMN[c] -> PI[c] + NAMD[c]
METTHF[c] + OMVAL[c] + H2O[c] -> THF[c] + AKP[c]
NADPH[c] + H[c] + AKP[c] -> NADP[c] + PANT[c]
ATP[c] + bALA[c] + PANT[c] -> H[c] + PPI[c] + AMP[c] + PNTO[c]
ATP[c] + PNTO[c] -> ADP[c] + 4PPNTO[c] + H[c]
CTP[c] + CYS[c] + 4PPNTO[c] -> PI[c] + CDP[c] + 4PPNCYS[c] + H[c]
4PPNCYS[c] <=> 4PPNTE[c] + CO2[c]
ATP[c] + 4PPNTE[c] + H[c] -> PPI[c] + DPCOA[c]
ATP[c] + DPCOA[c] -> ADP[c] + COA[c] + H[c]
APOACP[c] + COA[c] -> ACP[c] + H[c] + PAP[c]
DTB[c] + S[c] + SAM[c] -> BT[c] + H[c] + MET[c] + DAD5[c]
ATP[c] + BT[c] -> BTAMP[c] + PPI[c]
BTAMP[c] -> AMP[c] + BCCP[c]
ATP[c] + OCTA[c] + LCPE[c] <=> LCPENLYS[c] + AMP[c] + PPI[c]
C80ACP[c] + 2 SULDO[c] + 2 SAM[c] <=> LPACP[c] + 2 MET[c] + 2 DAD5[c] + 4 H[c]
OCT[c] + GCSH[c] <=> GCSHNLYS[c] + ACACP[c]
GCSHNLYS[c] + LCPE[c] <=> GCSH[c] + LCPENLYS[c]
78 DIH3TRIP[c] <=> PYRTETR[c] + PPPI[c]
CTP[c] <=> CCG[c] + NH3[c]
CCG[c] + ATP[c] + NH3[c] <=> PREQ0[c] + ADP[c] + PI[c] + H2O[c]
ACG[c] + 2 NADP[c] <=> CCG[c] + 2 NADPH[c] + 2 H[c]
THMP[e] + H2O[e] -> THME[e] + PI[e]
GDP[c] + H2O[c] <=> DIH3TRIP[c] + FOR[c]
GTP[c] + H2O[c] <=> FPYNTP[c]
FPYNTP[c] + H2O[c] -> DIANTP[c] + FOR[c] + 2 H[c]
DIANTP[c] -> DIATRPAO[c]
DIATRPAO[c] -> AHDT[c] + H2O[c]
AHDT[c] + 3 H2O[c] -> DHP[c] + 3 PI[c] + 2 H[c]
DHP[c] -> GLAL[c] + AHHMP[c]
ATP[c] + AHHMP[c] -> AMP[c] + AHHMD[c] + H[c]
PABA[c] + AHHMP[c] -> H2O[c] + DHPT[c]
ADCHOR[c] <=> PABA[c] + PYR[c]
CHOR[c] + GLU[c] <=> ADCHOR[c] + GLU[c]
PABA[c] + AHHMD[c] -> PPI[c] + DHPT[c]
ATP[c] + GLU[c] + DHPT[c] -> ADP[c] + PI[c] + DHF[c] + H[c]
GTP[c] -> CPMP[c] + PPI[c]
CDHGTP[c] + H2O[c] <=> PRECZ[c] + PPI[c]
PRECZ[c] + 2 THISULCP[c] <=> MOL[c] + 2 SULCP[c]
ATP[c] + MOL[c] <=> PPI[c] + AMOL[c]
AMOL[c] + MOL[c] <=> MOLMC[c] + AMP[c] + H2O[c]

MOLMC[c] + CTP[c] <=> CYTMC[c] + PPI[c]
ETRNA[c] + GLU[c] + ATP[c] <=> LGLUTRNA[c] + AMP[c] + PPI[c]
LGLUTRNA[c] + NADPH[c] + H[c] -> S4AMOXOPE[c] + ETRNA[c] + NADP[c]
S4AMOXOPE[c] -> AMIEVUL[c]
2 AMIEVUL[c] -> H[c] + 2 H2O[c] + PPBG[c]
H2O[c] + 4 PPBG[c] -> 4 NH3[c] + HMTB[c]
HMTB[c] -> UPGIII[c] + H2O[c]
UPGIII[c] + 4 H[c] -> CPGIII[c] + 4 CO2[c]
CPGIII[c] + 2 SALMET[c] <=> PPGIX[c] + 2 CO2[c] + 2 MET[c] + 2 DA[c]
PPGIX[c] + 3 O2[c] <=> PPRIX[c] + H2O2[c]
PPGIX[c] + FE2[c] <=> HEME[c] + 2 H[c]
FECOP[c] + 2 H2O2[c] <=> HEME[c] + 2 CO2[c] + 4 H2O[c]
2 SAM[c] + UPGIII[c] <=> 2 SAH[c] + PRE2[c]
PRE2[c] + NAD[c] <=> NADH[c] + H[c] + SHCR[c]
DBSHE[e] <=> FECOP[e]
COBSHCR[c] + 2 H[c] <=> SHCR[c] + 2 CO2[c]
SAM[c] + PRE2[c] <=> SAH[c] + PRE3A[c] + H[c]
SAM[c] + COPR3[c] + H[c] -> SAH[c] + COPR4[c]
H2O[c] + COPR5A[c] -> ACAL[c] + COPR5B[c]
SAM[c] + PRE4[c] <=> SAH[c] + PRE5[c]
PRE6Y[c] + NADP[c] <=> PRE6X[c] + NADPH[c] + H[c]
SAM[c] + COPR5B[c] -> SAH[c] + H[c] + COPR6[c]
2 SAM[c] + PRE6Y[c] <=> 2 SAH[c] + PRE8X[c] + CO2[c]
PRE8X[c] <=> HYBY[c]
2 H2O[c] + 2 ATP[c] + 2 GLN[c] + COBY[c] -> 2 ADP[c] + 2 PI[c] + 2 GLU[c] + 2 H[c] + COB2
COB1DIDE[c] + ATP[c] -> ADCODIE[c] + PPPI[c] + 2 H[c]
ADCODIE[c] + 4 GLN[c] + 4 ATP[c] + 4 H2O[c] -> ADCOHEX[c] + 4 GLU[c] + 4 PI[c] + 4 AD
ADOCBI[c] + ATP[c] <=> ADOCBIP[c] + ADP[c]
COBCE[c] + GMP[c] <=> AGDPCBI[c] + RIBAZ[c]
NAMN[c] + DIMBEN[c] <=> NICA[c] + N56DIM[c] + H[c]
2ME4P[c] + NADP[c] <=> DX5P[c] + NADPH[c] + H[c]
2ME4P[c] + CTP[c] + H[c] -> 4C2ME[c] + PPI[c]
ATP[c] + 4C2ME[c] -> ADP[c] + 2P4C2ME[c] + H[c]
2P4C2ME[c] -> 2MECDP[c] + CMP[c]
2MECDP[c] + NADH[c] -> H2MB4P[c] + H2O[c] + NAD[c]
H2MB4P[c] + NADH[c] + H[c] -> IPP[c] + NAD[c] + H2O[c]
H2MB4P[c] + RFER[c] + H[c] -> IPP[c] + OFER[c] + H2O[c]
H2MB4P[c] + RFER[c] + 2 H[c] -> DMPP[c] + OFER[c] + H2O[c]
H2MB4P[c] + NADH[c] + H[c] -> DMPP[c] + NAD[c] + H2O[c]
IPP[c] + DMPP[c] -> PPI[c] + GRDP[c]
IPP[c] + GRDP[c] -> PPI[c] + FRDP[c]
FRDP[c] + 4 IPP[c] -> ATHEDI[c] + 4 PPI[c]
HNO2[c] + 2 OFER[c] <=> HNO3[c] + 2 RFER[c] + 2 H[c]
H[c] + HCO3[c] <=> H2O[c] + CO2[c]
ETHT[c] + O2[c] + RFMN[c] <=> FMN[c] + HNO2[c] + ACAL[c] + H2O[c]
TRDRD[c] + PAPS[c] -> TRDOX[c] + H2SO3[c] + PAP[c] + H[c]
4 H[c] + 3 NADPH[c] + H2SO3[c] -> 3 H2O[c] + 3 NADP[c] + H2S[c]
H2S[c] + MQN8[c] -> S[c] + MQL8[c]
H2S[c] + OSLHSER[c] -> HCYS[c] + SUCC[c] + H[c]
H2O[c] + HCYS[c] -> NH3[c] + H2S[c] + OBUT[c] + H[c]
VACID[c] + NADPH[c] + H[c] + O2[c] <=> 3HDACID[c] + H2O[c]
2EDDPHPD[c] <=> 2E5MDPPYR[c]
6TAMOPH[c] + ATP[c] + GLN[e] + H2O[c] <=> 6TGMOPH[c] + PPI[c] + GLU[c] + AMP[c]
THGN[c] + PRPP[c] <=> 6TGMOPH[c] + PPI[c]
OAHSER[c] + METH[c] <=> MET[c] + AC[c]
NACE9PLO[c] + H2O[c] <=> NACE[c] + PI[c]
CTP[c] + NAN[c] <=> PPI[c] + CMPNAN[c]
UDPNAG[c] <=> UDPADLAHU[c] + H2O[c]
2 PPG[c] + H2O[c] -> PI[c] + GLYA[c]

NAD[c] + ETOL[c] -> NADH[c] + H[c] + ACAL[c]
N6LL[c] + NAD[c] + H2O[c] <=> LYS[c] + AKG[c] + NADH[c] + H[c]
LYS[c] <=> 15DAP[c] + CO2[c]
5APTAL[c] + NAD[c] + H2O[c] <=> 5APTA[c] + NADH[c] + H[c]
PTRSC[c] + PYR[c] <=> MIO[c] + ALA[c]
CAP[c] <=> SPRMD[c] + CO2[c]
ACCOA[c] + PHE[c] <=> COA[c] + NALPHE[c]
H2O[c] + ACE[c] -> NH3[c] + AC[c]
TRDOX[c] + NADPH[c] + H[c] -> TRDRD[c] + NADP[c]
ECYS[c] + CYS[c] <=> ESSUL[c] + ALA[c]
PENI[c] + H2O[c] <=> 6 APEN[c] + CAR[c]
ETHAM[c] -> ACAL[c] + NH3[c]
H2O[c] + LGT[c] -> H[c] + LAC[c] + RGT[c]
LAC[c] + 2 FE3[c] <=> 2 FE2[c] + PYR[c] + 2 H[c]
LACAL[c] + NADP[c] <=> MTHGXL[c] + NADPH[c] + H[c]
MAL[c] + NAD[c] -> PYR[c] + CO2[c] + NADH[c]
T3P2[c] -> MTHGXL[c] + PI[c]
ICIT[c] -> SUCC[c] + GLX[c]
GLY[c] + THF[c] + NAD[c] <=> METTHF[c] + NH3[c] + NADH[c] + CO2[c] + H[c]
OXAL[c] <=> FOR[c] + CO2[c]
ETHCOA[c] <=> C40COA[c] + CO2[c]
2 H[c] + PRPP[c] + PYR2CAR[c] -> CO2[c] + PPI[c] + NAMN[c]
NH3[c] + H2S[c] + OBUT[c] -> H2O[c] + HCYS[c]
H2O2[c] + METHOL[c] -> 2 H2O[c] + FALD[c]
ATP[c] + PPI[c] <=> ADP[c] + PPPI[c]
Q[c] + NADH[c] + 6 H[c] <=> QH2[c] + NAD[c] + 5 H[c]
4 FERO[c] + 4 H[c] + O2[c] <=> 4 FERO[c] + 2 H2O[c]
2 MQL[c] + O2[c] <=> 2 MQN[c] + 2 H2O[c]
2 QH2[c] + O2[c] + 4 H[c] -> 2 Q[c] + 2 H2O[c] + 4 H[c]
2 QH2[c] <=> 2 Q[c] + 4 H[c]
H2O[c] + PPI[c] -> 2 PI[c] + H[c]
FE2[c] + SHCR[c] <=> SIHM[c] + 2 H[c]
HEME[c] + H2O[c] + FRDP[c] <=> HEMEO[c] + DP[c]
ANTCOA[c] + 2 MALCOA[c] <=> 2 METOL[c] + 3 CO2[c] + 3 COA[c]
DMMQL[c] + SAM[c] <=> MQL[c] + SAH[c]
DMPP[c] + TRNAA[c] <=> PPI[c] + TRNAC6ISO[c]
ICHOR[c] + H2O[c] <=> DIHB[c] + PYR[c]
DIHB[c] + NAD[c] <=> DIHB[c] + NADH[c] + H[c]
6 ATP[c] + 3 DIH[c] + 3 SER[c] <=> AMP[c] + 6 PPI[c] + ENT[c]
DIH[c] + NAD[c] <=> ANT[c] + NADH[c] + H[c]
ANT[c] + ALA[c] + ATP[c] <=> BAC[c] + PI[c] + ADP[c]
SUCCOA[c] + NADPH[c] + H[c] -> SUCCSAL[c] + COA[c] + NADP[c]
ATP[c] + 7 COA[c] + 7 FAD[c] + 7 NAD[c] + PMTCOA[c] + 8 H2O[c] -> 8 ACCOA[c] + 7 FAD
H2O[c] + G3PG[c] <=> GL3P[c] + GL[c] + H[c]
PA[c] + H2O[c] -> DAGL[c] + PI[c]
PG[c] + CDPDG[c] -> CL[c] + CMP[c]
BSGPHO[c] + 8 NAD[c] <=> BGPHO[c] + 8 NADH[c] + 8 H[c]
IMP[c] + NADP[c] + NH3[c] -> GMP[c] + NADPH[c] + H[c]
H2O[c] + PAP[c] -> PI[c] + AMP[c]
CPAD5P[c] + H[c] -> IGP[c] + CO2[c] + H2O[c]
ECT[c] + H2O[c] <=> NACE24DIA[c]
ACCOA[c] + PYR[c] + H2O[c] <=> R2MMAL[c] + COA[c]
PRBATP[c] + DP[c] <=> PRPP[c] + ATP[c]
UDPADG[c] + DGNDGR[c] <=> UDP[c] + DGDGNACEGR[c]
DGDMHBIS[c] + H2O[c] <=> DGDMHBIS[c] + PI[c]
UDPADLT[c] + NADP[c] <=> UDPADLAHU[c] + NADPH[c] + H[c]
UNLDDD[e] + GMADIP[e] <=> UDCPDP[e] + GMADIP[e]
ACMUMA[e] + H2O[e] <=> ACMUM[e] + ALA[e]

UDPNAG[c] + UDCPP[c] <=> NAGLU[c] + UMP[c]
H2O[c] + ATP[c] + CO2[c] + BCCP[c] -> 2 H[c] + PI[c] + ADP[c] + CBCCP[c]
METHF[c] + H2O[c] -> 5FTHF[c] + H[c]
GLY[c] -> 3 H[c] + IMGLY[c]
T3P2[e] + H2O[e] -> GLYN[e] + PI[e]
2 FRDP[c] -> PPI[c] + PREQ2P[c]
4 NPHO[c] + H2O[c] <=> 4 NOL[c] + PI[c]
HALD[c] + H2O[c] <=> HYD[c] + HAL[c]
UDPNAG[c] + UDCPP[c] -> UMP[c] + UDNAG[c]
ACCOA[c] + ACP[c] -> COA[c] + ACACP[c]
ATP[c] + GTP[c] -> H[c] + AMP[c] + pppGpp[c]
2 O2S[c] + 2 H[c] -> O2[c] + H2O2[c]
RH[c] + CYS[c] + H[c] <=> RSH[c] + ALA[c]
TRP[c] + YTRNA[c] + ATP[c] -> AMP[c] + TRPTRNA[c] + PPI[c]
SECAL[c] + NADP[c] <=> KET[c] + NADPH[c] + H[c]
MI1P[e] + H2O[e] -> MYOI[e] + PI[e]
ILE[c] + ITRNA[c] + ATP[c] -> AMP[c] + LILEUTRNA[c] + PPI[c]
4PPNCYS[c] + H[c] -> CO2[c] + 4PPTINE[c]
PSERPI[c] + H2O[c] -> PSER[c] + PI[c]
PSER[c] + ATP[c] -> PSERPI[c] + ADP[c] + H[c]
METTHF[c] + URA[c] + NADP[c] + H[c] -> NADPH[c] + 5METURA[c] + THF[c]
PGLU[c] + H2O[c] -> METHOL[c] + H[c] + PGLUOME[c]
PGLN[c] + H2O[c] -> NH4[c] + PGLUOME[c]
PTRNA[c] + PRO[c] + ATP[c] -> LPROTRNA[c] + AMP[c] + PPI[c]
RIBN[c] + PI[c] -> NPPI[c] + RIBN[c]
SAM[c] + PGLU[c] -> SAH[c] + PGLUOME[c]
TRNAP[c] + 2 CTP[c] + ATP[c] -> 3 PI[c] + TRNAC3CCA[c]
7AM7DEGS[c] + SAM[c] -> EPQS[c] + AD[c] + MET[c]
HTRNA[c] + HIS[c] + ATP[c] -> HHTRNA[c] + AMP[c] + PI[c]
DTRNA[c] + ASN[c] + ATP[c] -> ASPTRNA[c] + AMP[c] + PI[c]
ATRNA[c] + ALA[c] + ATP[c] -> ALATRNA[c] + AMP[c] + PI[c]
TRDRD[c] + H2O2[c] -> OXTRD[c] + 2 H2O[c]
GTRNA[c] + GLY[c] + ATP[c] -> GLYTRNA[c] + AMP[c] + PI[c]
METTHF[c] + NADP[c] <=> METHF[c] + NADPH[c]
ATP[c] + COA[c] + HEXA[c] -> AMP[c] + PPI[c] + C60COA[c]
ACAL[c] + COA[c] + NAD[c] -> ACCOA[c] + NADH[c] + H[c]
CROCOA[c] + 2 NADH[c] + 2 OFER[c] -> C40COA[c] + 2 NAD[c] + 2 RFER[c]
C40COA[c] + ACCOA[c] -> OC60COA[c] + COA[c]
OC60COA[c] + NADH[c] + H[c] -> HC60COA[c] + NAD[c]
HC60COA[c] -> H2ECOA[c] + H2O[c]
H2ECOA[c] + 2 OFER[c] + 2 NADH[c] -> C60COA[c] + 2 RFER[c] + 2 NAD[c]
C60COA[c] + BUAC[c] -> C40COA[c] + HEXA[c]
H[e] + HEXA[e] <=> H[c] + HEXA[c]
ATP[c] + H2O[c] + SPRMD[e] -> ADP[c] + H[c] + PI[c] + SPRMD[c]
ATP[c] + H2O[c] + PTRSC[e] -> ADP[c] + H[c] + PI[c] + PTRSC[c]
ATP[c] + H2O[c] + GLYB[e] -> ADP[c] + H[c] + PI[c] + GLYB[c]
ATP[c] + H2O[c] + PRO[e] -> ADP[c] + H[c] + PI[c] + PRO[c]
ATP[c] + H2O[c] + CHO[e] -> ADP[c] + H[c] + PI[c] + CHO[c]
ATP[c] + H2O[c] + CAR[e] -> ADP[c] + H[c] + PI[c] + CAR[c]
ATP[c] + H2O[c] + TRILAT[e] -> ADP[c] + H[c] + PI[c] + TRILAT[c]
ATP[c] + H2O[c] + ADN[e] -> ADP[c] + H[c] + PI[c] + ADN[c]
ATP[c] + H2O[c] + INS[e] -> ADP[c] + H[c] + PI[c] + INS[c]
ATP[c] + H2O[c] + UR[e] -> ADP[c] + H[c] + PI[c] + UR[c]
ATP[c] + H2O[c] + DG[e] -> ADP[c] + H[c] + PI[c] + DG[c]
ATP[c] + H2O[c] + GSN[e] -> ADP[c] + H[c] + PI[c] + GSN[c]
ATP[c] + H2O[c] + CYTD[e] -> ADP[c] + H[c] + PI[c] + CYTD[c]
ATP[c] + H2O[c] + DU[e] -> ADP[c] + H[c] + PI[c] + DU[c]
ATP[c] + H2O[c] + DA[e] -> ADP[c] + H[c] + PI[c] + DA[c]

ATP[c] + H2O[c] + DC[e] -> ADP[c] + H[c] + PI[c] + DC[c]
ATP[c] + H2O[c] + XTSINE[e] -> ADP[c] + H[c] + PI[c] + XTSINE[c]
ATP[c] + H2O[c] + DIN[e] -> ADP[c] + H[c] + PI[c] + DIN[c]
ATP[c] + H2O[c] + PI[e] -> ADP[c] + H[c] + 2 PI[c]
ATP[c] + H2O[c] + ASP[e] -> ADP[c] + H[c] + PI[c] + ASP[c]
ATP[c] + H2O[c] + GLU[e] -> ADP[c] + H[c] + PI[c] + GLU[c]
ATP[c] + H2O[c] + GLN[e] -> ADP[c] + H[c] + PI[c] + GLN[c]
ATP[c] + H2O[c] + CYS[e] -> ADP[c] + H[c] + PI[c] + CYS[c]
ATP[c] + H2O[c] + ARG[e] -> ADP[c] + H[c] + PI[c] + ARG[c]
ATP[c] + H2O[c] + LYS[e] -> ADP[c] + H[c] + PI[c] + LYS[c]
ATP[c] + H2O[c] + HIS[e] -> ADP[c] + H[c] + PI[c] + HIS[c]
ATP[c] + H2O[c] + VAL[e] -> ADP[c] + H[c] + PI[c] + VAL[c]
ATP[c] + H2O[c] + LEU[e] -> ADP[c] + H[c] + PI[c] + LEU[c]
ATP[c] + H2O[c] + ILE[e] -> ADP[c] + H[c] + PI[c] + ILE[c]
ATP[c] + H2O[c] + THR[e] -> ADP[c] + H[c] + PI[c] + THR[c]
ATP[c] + H2O[c] + DMET[e] -> ADP[c] + H[c] + PI[c] + DMET[c]
ATP[c] + H2O[c] + OPD[e] -> ADP[c] + H[c] + PI[c] + OPD[c]
ATP[c] + H2O[c] + NI[e] -> ADP[c] + H[c] + PI[c] + NI[c]
ATP[c] + H2O[c] + ZN[e] -> ADP[c] + H[c] + PI[c] + ZN[c]
ATP[c] + H2O[c] + COBALT2[e] -> ADP[c] + H[c] + PI[c] + COBALT2[c]
ATP[c] + H2O[c] + BT[e] -> ADP[c] + H[c] + PI[c] + BT[c]
ATP[c] + H2O[c] + BAC[e] -> ADP[c] + H[c] + PI[c] + BAC[c]
ATP[c] + H2O[c] + ALAHIS[e] -> ADP[c] + H[c] + PI[c] + ALAHIS[c]
NA[e] <=> NA[c]
MG[e] <=> MG[c]
S[e] <=> S[c]
NA2SO4[c] -> NA2SO4[e]
AACID[e] + NA[e] <=> AACID[c] + NA[c]
ILE[e] + H[e] -> ILE[c] + H[c]
AACID[e] + H[e] -> AACID[c] + H[c]
VAL[e] + NA[e] -> VAL[c] + NA[c]
PHE[e] + H[e] <=> PHE[c] + H[c]
LYS[e] + H[e] <=> LYS[c] + H[c]
K[e] <=> K[c]
CA2[e] <=> CA2[c]
BT[e] + ATP[c] -> BT[c] + ADP[c] + PI[c]
G[e] <=> G[c]
CA[e] <=> CA[c]
FE2[e] <=> FE2[c]
FE3[e] <=> FE3[c]
OMP[e] <=> OMP[c]
SLF[e] <=> SLF[c]
UMP[e] <=> UMP[c]
URA[e] <=> URA[c]
UREA[e] <=> UREA[c]
AC[e] <=>
ETOL[e] <=>
PROL[e] <=>
CRO[e] <=>
VAC[e] <=>
PROP[e] <=>
BUAC[e] <=>
PENT[e] <=>
HEPT[e] <=>
H2[e] <=>
CO2[e] <=>
HCO3[e] <=>
ALA[e] <=>

ARG[e] <=>
ASN[e] <=>
ASP[e] <=>
CYS[e] <=>
GLN[e] <=>
GLU[e] <=>
GLY[e] <=>
HIS[e] <=>
ILE[e] <=>
LEU[e] <=>
LYS[e] <=>
MET[e] <=>
PHE[e] <=>
PRO[e] <=>
SER[e] <=>
THR[e] <=>
TRP[e] <=>
TYR[e] <=>
VAL[e] <=>
FUM[e] <=>
PHE[e] <=>
UREA[e] <=>
GLU[e] <=>
OMP[e] <=>
HDBUT[e] <=>
MAL[e] <=>
O2[e] <=>
OA[e] <=>
PA[c] <=>
SER[e] <=>
SUCC[e] <=>
UDPG[e] <=>
URA[e] <=>
URI[e] <=>
HEXA[e] <=>
OXAL[e] <=>
HCO3[e] <=>
GL[e] <=>
MNT[e] <=>
AC[e] <=>
BUT[e] <=>
LAC[e] <=>
GLC[e] <=>
COBALT2[e] <=>
MN2[e] <=>
NH4[e] <=>
BT[e] <=>
CA[e] <=>
FE3[e] <=>
K[e] <=>
NA[e] <=>
CHL[e] <=>
H2PO4[e] <=>
HPO4[e] <=>
MG[e] <=>
SLF[e] <=>
H2O[e] <=>
FTHF[c] + GAR[c] <=> H[c] + THF[c] + FGAR[c]

GLU[c] <=> DGLU[c]
ACP[c] + MALCOA[c] <=> COA[c] + MALACP[c]
ACACP[c] + 6 MALACP[c] + 12 NADPH[c] + 18 H[c] -> 12 NADP[c] + C140ACP[c] + 6 CO2[c]
PROPACP[c] + 6 MALACP[c] + 12 NADPH[c] + 18 H[c] -> 12 NADP[c] + C150ACP[c] + 6 CO2
ACACP[c] + 7 MALACP[c] + 14 NADPH[c] + 21 H[c] -> 14 NADP[c] + C160ACP[c] + 7 CO2[c]
ACACP[c] + 7 MALACP[c] + 13 NADPH[c] + 16 H[c] -> 13 NADP[c] + C161ACP[c] + 7 CO2[c]
PROPACP[c] + 7 MALACP[c] + 14 NADPH[c] + 21 H[c] -> 14 NADP[c] + C170ACP[c] + 7 CO2
NAD[c] + GL[c] <=> NADH[c] + H[c] + GLYAL[c]
9 C140ACP[c] + 82 C150ACP[c] + 5 C160ACP[c] + 2 C170ACP[c] + 2 C161ACP[c] + GL3P[c] -
AGLY3P[c] + 10 C140ACP[c] + 82 C150ACP[c] + 5 C160ACP[c] + 2 C170ACP[c] + 2 C161ACP
ATP[c] + PG[c] + LYS[c] -> AMP[c] + LYSPG[c] + H[c] + PPI[c]
2 PG[c] -> CL[c] + GL[c]
DAGL[c] + UDPG[c] -> M12DG[c] + H[c] + UDP[c]
DAGL[c] + 2 UDPG[c] -> D12DG[c] + 2 H[c] + 2 UDP[c]
DAGL[c] + 3 UDPG[c] -> T12DG[c] + 3 H[c] + 3 UDP[c]
CRO[c] + NADH[c] + H[c] <=> BUAC[c] + NAD[c]
45 CDPGL[c] + UDPNAG[c] + UACMAM[c] -> 45 CMP[c] + GTA[c] + UDP[c] + UMP[c] + 46 H
45 DALA[c] + 45 ATP[c] + 45 CDPGL[c] + 45 H2O[c] + UDPNAG[c] + UACMAM[c] -> 45 AM
45 CDPGL[c] + H2O[c] + UDPNAG[c] + UACMAM[c] + 45 UDPG[c] -> 45 CMP[c] + GTA3[c]
30 H2O[c] + 30 UDPNAGA[c] + 30 UDPG[c] -> MGTA[c] + 30 UDP[c] + 30 UMP[c] + 60 H[c]
24 CDPGL[c] + D12DG[c] + 24 UDPG[c] -> 24 CMP[c] + LIPOTA[c] + 24 UDP[c] + 48 H[c]
24 CDPGL[c] + D12DG[c] + 24 UDPNAG[c] -> 24 CMP[c] + LIPO2[c] + 24 UDP[c] + 48 H[c]
24 DALA[c] + 24 ATP[c] + 24 CDPGL[c] + D12DG[c] + 24 H2O[c] -> 24 AMP[c] + 24 CMP[c] +
24 CDPGL[c] + D12DG[c] -> 24 CMP[c] + LIPO4[c] + 24 H[c]
PG[c] + DGDAGL[c] -> DAGL[c] + GPGGL[c]
DTTP[c] + CYTD[c] -> CMP[c] + DTDP[c]
PROPCOA[c] + ACP[c] <=> PROPACP[c] + COA[c]
NAD[c] + H2O[c] + GLAL[c] -> 2 H[c] + NADH[c] + GLYA[c]
H[c] + NADH[c] + GLX[c] <=> NAD[c] + GLYA[c]
ACP[c] <=>
RFER[c] <=>
NADPH[c] + H[c] + DHF[c] <=> NADP[c] + THF[c]

H2O[c] + ATP[c] + CO2[c] + BCCP[c] -> 2 H[c] + PI[c] + ADP[c] + CBCCP[c]
NAD[c] + COA[c] + AKA[c] -> NADH[c] + CO2[c] + GLTCOA[c]
NAD[c] + 3PG[c] -> H[c] + NADH[c] + PHP[c]
2345THP[c] + ACCOA[c] + H2O[c] -> ACAMOXM[c] + COA[c]
H2O[c] + CGLY[c] -> GLY[c] + CYS[c]
H2O[c] + PRBAMP[c] -> PRFP[c]
H[c] + 4PPNCYS[c] -> CO2[c] + 4PPNTE[c]
PRPP[c] + GN[c] -> PPI[c] + GMP[c]
ACCOA[c] + GA1P[c] -> H[c] + COA[c] + NAGA1P[c]
NACMA[c] + H2O[c] <=> MURNAC[c] + ALA[c]
METRO[c] + THIOR[c] -> H2O[c] + MET[c] + OTHIO[c]
ATP[c] + RIBFLAV[c] -> ADP[c] + H[c] + FMN[c]
ACCOA[c] + HSER[c] -> COA[c] + OAHSER[c]
H2O[c] + DUTP[c] -> 2 H[c] + PPI[c] + DUMP[c]
6 H[c] + 4 NADPH[c] + 2 MALACP[c] + MMEACP[c] -> 2 H2O[c] + 2 CO2[c] + 4 NADP
0.0317 DATP[c] + 0.0192 DGTP[c] + 0.0192 DCTP[c] + 0.0317 DTTP[c] + 0.06574 ATP[c] + 0.0

| GPR | EC Numbe | Notes |
|---|---|---|
| JGZ98_00290 | 5.4.2.2 | |
| JGZ98_12465 | 5.3.1.9 | |
| JGZ98_06685 | 3.1.3.11 | |
| JGZ98_13945 | 2.7.1.11 | |
| JGZ98_06700 | 4.1.2.13 | |
| JGZ98_04450 | 5.3.1.1 | |
| JGZ98_13635 | 1.2.1.9 | |
| JGZ98_04460 or JGZ98_13880 | 1.2.1.12 | |
| JGZ98_04455 | 2.7.2.3 | |
| JGZ98_04445 or JGZ98_13375 | 5.4.2.12 | |
| JGZ98_04440 | 4.2.1.11 | |
| JGZ98_13940 | 2.7.1.40 | |
| JGZ98_16175 | 1.1.1.27 | |
| JGZ98_00980 and JGZ98_00990 | | lump reaction |
| | 4.1.1.1 | |
| JGZ98_00730 | 1.2.1.3 | |
| JGZ98_09425 or JGZ98_14030 | 6.2.1.1 6.2.1.13 | |
| JGZ98_01105 or JGZ98_01680 | 6.4.1.1 | |
| JGZ98_01665 | 2.3.3.1 | |
| JGZ98_12280 | 4.2.1.3 | |
| JGZ98_13920 | 1.1.1.42 | |
| JGZ98_14460 or JGZ98_14465 | | lump reaction |
| JGZ98_01690 or JGZ98_01685 | 6.2.1.5 | |
| JGZ98_14895 | 2.8.3.18 | |
| JGZ98_09225 or JGZ98_09220 | 1.3.5.1 1.3.5.4 | |
| JGZ98_04095 or JGZ98_17815 | 4.2.1.2 | |
| JGZ98_18480 | 1.1.5.4 | |
| JGZ98_13915 | 1.1.1.37 | |
| JGZ98_09680 | 4.1.1.49 | |
| JGZ98_16420 | 1.1.99.3 | |
| JGZ98_11790 | 1.1.1.215 | |
| JGZ98_02180 | 2.7.1.12 | |
| JGZ98_02175 | 1.1.1.44 1.1.1.343 | |
| JGZ98_06615 or JGZ98_07180 | 5.3.1.6 | |
| JGZ98_02385 | 5.4.2.7 | |
| JGZ98_13030 | 2.7.6.1 | |
| JGZ98_05465 | 4.1.2.43 | |
| JGZ98_05465 | 5.3.1.27 | |
| JGZ98_06695 | 2.2.1.2 | |
| | 4.1.2.4 | |
| JGZ98_02385 | 5.4.2.7 | |
| JGZ98_02325 | 2.2.1.1 | |
| JGZ98_02325 | 2.2.1.1 | |
| JGZ98_01510 | 5.1.3.1 | |
| JGZ98_00245 | 2.7.7.13 | |
| JGZ98_16010 | 1.1.1.281 | |
| JGZ98_00220 or JGZ98_16120 or JGZ98_16015 | 5.1.3.2 | |
| | 2.7.7.9 | gap |
| JET15_12750 or JET15_12765 or JET15_12745 | 2.2.1.6 | KAAS |
| JET15_07820 or JET15_12730 | 1.1.1.157 | KAAS |
| JET15_07840 or JET15_13745 | 4.2.1.17 | KAAS |
| | | gap |
| | 3.6.3.14 | |
| | | KAAS |
| JGZ98_06750 or JGZ98_11570 or JGZ98_12605 | 2.3.1.9 | |
| JGZ98_12595 | 2.8.3.5 | |
| JGZ98_12615 | 1.1.1.30 | |

| | |
|---|---|
| JGZ98_09860 or JGZ98_05710 | 5.4.4.2 |
| JGZ98_09855 | 2.2.1.9 |
| JGZ98_09850 | 4.2.99.20 |
| JGZ98_08525 | 4.2.1.113 |
| JGZ98_09835 | 6.2.1.26 |
| JGZ98_09845 | 4.1.3.36 |
| | 3.1.2.28 gap |
| JGZ98_13435 | 2.5.1.74 |
| JGZ98_02645 | 2.1.1.163 |
| JGZ98_07775 | 1.6.5.2 |
| | 2.5.1.90 gap |
| JGZ98_16600 | 2.6.1.1 |
| JGZ98_02220 | 6.3.1.2 |
| JGZ98_12130 | 3.5.1.2 |
| JGZ98_11775 or JGZ98_16965 | 1.4.1.4 |
| JGZ98_15580 | 2.6.1.16 |
| | 2.3.1.1 |
| JGZ98_16255 | 2.7.2.8 |
| JGZ98_16265 | 1.2.1.38 |
| JGZ98_16250 | 2.6.1.11 |
| JGZ98_16260 | 2.3.1.35 2.3.1.1 |
| JGZ98_09355 | 2.1.3.3 |
| JGZ98_18140 | 6.3.4.5 |
| JGZ98_09010 or JGZ98_18145 | 4.3.2.1 |
| JGZ98_15645 | 3.5.3.1 |
| JGZ98_07865 | 6.3.4.6 3.5.1.54 |
| JGZ98_07860 | 3.5.1.54 |
| JGZ98_08225 or JGZ98_08230 or JGZ98_08235 | 3.5.1.5 |
| JGZ98_02365 | 3.6.1.13 |
| JGZ98_12120 | 2.4.2.14 |
| JGZ98_12100 | 6.3.4.13 |
| JGZ98_12110 | 2.1.2.2 |
| JGZ98_12125 or JGZ98_12135 or JGZ98_12130 | 6.3.5.3 |
| JGZ98_12115 | 6.3.3.1 |
| JGZ98_12150 | 6.3.4.18 |
| JGZ98_12155 | 5.4.99.18 |
| JGZ98_12140 | 6.3.2.6 |
| JGZ98_12145 | 4.3.2.2 |
| JGZ98_12105 | 2.1.2.3 3.5.4.10 |
| | 3.5.4.10 |
| JGZ98_17760 | 6.3.4.4 |
| JGZ98_12145 | 4.3.2.2 |
| JGZ98_11380 | 2.7.4.3 |
| JGZ98_02655 | 2.7.4.6 |
| JGZ98_04020 or JGZ98_12780 or JGZ98_12785 | 1.17.4.1 |
| JGZ98_02655 | 2.7.4.6 |
| JGZ98_02655 | 2.7.4.6 modelSEED |
| JGZ98_11380 | 2.7.4.3 |
| JGZ98_04105 | 3.1.3.5 |
| JGZ98_16640 | 2.7.1.76 2.7.1.74 |
| JGZ98_12105 or JGZ98_03145 | 2.4.2.7 |
| JGZ98_04105 | 3.1.3.5 |
| JGZ98_04105 | 3.1.3.5 |
| JGZ98_14530 | 2.4.2.1 |
| | 2.4.2.1 |
| JGZ98_08470 or JGZ98_12090 | 3.5.4.2 |
| | 2.4.2.1 |
| JGZ98_16690 | 1.1.1.205 |

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|---|---|---|
| JGZ98_17510 | 6.3.5.2 | |
| JGZ98_01455 | 2.7.4.8 | |
| JGZ98_16710 | 1.17.4.1 | |
| JGZ98_02655 | 2.7.4.6 | |
| JGZ98_01455 | 2.7.4.8 | |
| JGZ98_18530 | 2.7.1.113 | |
| | 2.4.2.1 | |
| JGZ98_17050 | 2.4.2.8 2.4.2.22 | |
| | 2.4.2.1 | |
| JGZ98_04105 | 3.1.3.5 | |
| JGZ98_18155 | 3.5.4.3 | |
| JGZ98_17875 or JGZ98_17930 or JGZ98_17935 or JG | 1.17.1.4 | |
| | 2.4.2.1 | |
| JGZ98_04105 | 3.1.3.5 | |
| JGZ98_17875 or JGZ98_17930 or JGZ98_17935 or JG | 1.17.1.4 | |
| JGZ98_18595 | 1.7.3.3 | |
| JGZ98_18600 | 3.5.2.17 | |
| JGZ98_04455 | 4.1.1.97 | |
| JGZ98_17845 | 3.5.2.5 | |
| JGZ98_15195 | 3.5.3.9 | |
| JGZ98_17870 | 2.6.1.112 | |
| | 3.5.3.4 | gap |
| JGZ98_04105 | 3.5.1.5 | |
| JGZ98_11495 | 3.1.4.16 | |
| JGZ98_04105 | 3.1.3.6 | |
| JGZ98_05670 | 2.7.7.4 | |
| JGZ98_05665 | 2.7.1.25 | |
| | 6.3.4.18 | gap filling by KEGG |
| JGZ98_02655 | 2.7.4.6 | |
| JGZ98_09195 | 3.6.1.66 | |
| | 3.6.1.66 | KAAS |
| JGZ98_01405 or JGZ98_01400 | 6.3.5.5 | |
| JGZ98_01390 | 2.1.3.2 | |
| JGZ98_01395 | 3.5.2.3 | |
| JGZ98_01415 | 1.3.1.14 | |
| JGZ98_01425 | 2.4.2.10 | |
| JGZ98_01420 | 4.1.1.23 | |
| JGZ98_04105 | 3.1.3.5 | |
| | 2.4.2.3 | gap |
| JGZ98_10525 or JGZ98_10530 | 1.3.1.1 | |
| JGZ98_10520 | 3.5.2.2 | |
| JGZ98_10515 | 3.5.1.6 | |
| JGZ98_03300 | 2.7.1.48 | |
| JGZ98_01915 | 2.7.4.22 | |
| JGZ98_06715 | 6.3.4.2 | |
| JGZ98_07745 | 3.5.4.13 | |
| JGZ98_02655 | 2.7.4.6 | |
| JGZ98_02585 | 2.7.4.25 | |
| JGZ98_04105 | 3.1.3.5 | |
| | 3.5.4.5 | |
| | 3.5.4.1 | |
| | 2.4.2.2 | |
| | 1.17.4.2 | gap |
| JGZ98_02655 | 2.7.4.6 | |
| JGZ98_16440 | 3.6.1.12 | |
| | 2.7.4.14 | |
| JGZ98_16640 | 2.7.1.74 | |
| JGZ98_04105 | 3.1.3.5 | |

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| | 3.5.4.5 | |
| | 2.4.2.1 | |
| JGZ98_07745 | 3.5.4.13 | |
| JGZ98_02655 | 2.7.4.6 | |
| JGZ98_16710 | 1.17.4.1 | |
| | 2.7.4.9 | |
| JGZ98_06670 | 2.7.1.21 | |
| JGZ98_04105 | 3.1.3.5 | |
| JGZ98_14585 | 2.1.1.45 | |
| | 2.7.4.9 | |
| JGZ98_02655 | 2.7.4.6 | |
| JGZ98_04105 | 3.1.3.5 | |
| | 2.4.2.4 | gap |
| JGZ98_10525 or JGZ98_10530 | 1.3.1.1 | |
| JGZ98_10520 | 3.5.2.2 | |
| JGZ98_10515 | 3.5.1.6 | |
| JGZ98_13995 | 1.4.1.1 | |
| JGZ98_06240 or JGZ98_13430 | 6.3.5.4 | |
| JGZ98_02560 | 3.5.1.1 | |
| JGZ98_15105 | 1.4.3.16 | |
| | 2.6.1.14 | gap |
| JGZ98_06995 | 3.5.1.3 | |
| JGZ98_06255 | 5.1.1.13 | |
| | 1.4.3.1 | |
| JGZ98_18140 | 6.3.4.5 | |
| JGZ98_06995 | 3.5.1.3 | |
| JGZ98_14310 or JGZ98_14315 | 1.4.1.13 | |
| JGZ98_02780 | 6.3.2.1 | |
| JGZ98_15580 | 2.6.1.16 | |
| JGZ98_01405 or JGZ98_01400 | 6.3.5.5 | |
| JGZ98_16975 | 1.2.1.88 | |
| JGZ98_09365 | 4.1.1.15 | |
| JGZ98_05090 | 2.6.1.19 | |
| JGZ98_05085 | 1.2.1.16 1.2.1.79 1.2.1.20 | |
| JGZ98_11790 | 1.1.1.81 | |
| | 2.7.1.165 | gap |
| JGZ98_04815 | 1.1.1.95 | |
| | 2.6.1.52 | gap |
| | 3.1.3.3 | gap |
| JGZ98_01545 or JGZ98_01550 or JGZ98_06930 or JG | 4.3.1.17 | |
| JGZ98_10665 | 4.3.1.18 | |
| JGZ98_16610 | 5.1.1.18 | |
| JGZ98_10235 or JGZ98_10230 | 4.2.1.20 | |
| JGZ98_06605 | 2.1.2.1 | |
| JGZ98_04000 or JGZ98_04005 | 1.4.4.2 | |
| JGZ98_03995 | 2.1.2.10 | |
| JGZ98_00995 or JGZ98_04225 | 1.8.1.4 | |
| JGZ98_07015 | 2.3.1.29 | |
| JGZ98_08610 | 1.4.3.21 | |
| JGZ98_09015 | 4.1.2.48 | |
| JGZ98_06930 | 4.3.1.19 | |
| JGZ98_09240 or JGZ98_11740 | 2.7.2.4 | |
| JGZ98_02030 | 1.2.1.11 | |
| JGZ98_02035 or JGZ98_06000 | 4.3.3.7 | |
| JGZ98_02750 | 1.17.1.8 | |
| JGZ98_13630 | 1.1.1.3 | |
| JGZ98_15690 | 1.1.1.3 | |
| JGZ98_16400 | 2.7.1.39 | |

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| JGZ98_16050 or JGZ98_16405 | 4.2.3.1 | |
| JGZ98_03330 | 2.7.8.8 | |
| | 4.2.1.22 | gap |
| JGZ98_17595 | 4.4.1.1 | |
| JGZ98_09005 | 2.8.5.1 | |
| JGZ98_06210 or JGZ98_13160 | 2.5.1.47 | |
| JGZ98_18690 or JGZ98_06210 or JGZ98_13160 | 2.5.1.144 | |
| JGZ98_11165 | 2.3.1.30 | |
| JGZ98_01545 or JGZ98_01550 or JGZ98_06930 or JG | 4.3.1.17 | |
| JGZ98_06210 or JGZ98_13160 | 2.5.1.47 | |
| | 4.4.1.10 | gap |
| JGZ98_16600 | 2.6.1.1 | |
| JGZ98_13915 | 1.1.1.37 | |
| | 4.4.1.24 | |
| JGZ98_16175 | 1.1.1.27 | |
| JGZ98_06100 or JGZ98_11825 | 2.8.1.2 | |
| JGZ98_16600 | 2.6.1.1 | |
| | 4.1.1.12 | gap |
| JGZ98_17000 | 4.4.1.13 | |
| JGZ98_05610 | 2.1.1.13 | |
| JGZ98_05085 | 1.8.4.14 | |
| JGZ98_07000 | 2.6.1.117 | |
| JGZ98_09675 | 2.5.1.6 | |
| JGZ98_05315 | 2.1.1.- | |
| JGZ98_03320 | 3.2.2.9 | |
| JGZ98_04630 | 4.4.1.21 | |
| JGZ98_17590 | 2.5.1.134 | |
| JGZ98_16220 | 2.3.1.46 | |
| JGZ98_04645 | 2.5.1.48 | |
| JGZ98_04645 | 2.5.1.48 | |
| JGZ98_04220 | 1.4.1.9 | |
| JGZ98_04230 | 1.2.4.4 | |
| JGZ98_04235 | 1.2.4.4 | |
| JGZ98_00995 or JGZ98_04225 | 1.8.1.4 | |
| JGZ98_04240 | 2.3.1.168 | |
| | 1.3.8.4 | gap |
| JGZ98_18100 or JGZ98_05595 or JGZ98_09265 | 4.2.1.17 | |
| | 4.2.1.18 | gap |
| | 4.1.3.4 | gap |
| | 3.1.2.4 | gap |
| JGZ98_12235 | 2.6.1.42 | |
| JGZ98_04230 | 1.2.4.4 | |
| JGZ98_00995 or JGZ98_04225 | 1.8.1.4 | |
| JGZ98_04240 | 2.3.1.168 | |
| | 1.3.8.7 | gap |
| JGZ98_18100 or JGZ98_05595 or JGZ98_09265 | 4.2.1.17 | |
| JGZ98_04230 | 1.2.4.4 | |
| JGZ98_04230 | 1.2.4.4 | |
| JGZ98_04240 | 2.3.1.168 | |
| | 1.3.8.1 | |
| JGZ98_18100 or JGZ98_05595 or JGZ98_09265 | 4.2.1.17 | |
| JGZ98_14255 | 1.1.1.35 | |
| JGZ98_14260 | 2.3.1.16 | |
| JGZ98_04320 | 6.4.1.3 | |
| JGZ98_04315 | 5.1.99.1 | |
| JGZ98_04245 or JGZ98_04250 | 5.4.99.2 | |
| JGZ98_00800 | 1.1.1.31 | |
| JGZ98_05090 | 2.6.1.22 | |

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| JGZ98_00730 | 1.2.1.3 | |
| JGZ98_12270 | 4.2.1.35 | |
| JGZ98_12270 | 4.2.1.35 | |
| JGZ98_12260 | 1.1.1.85 | |
| JGZ98_06930 | 4.3.1.19 | |
| JGZ98_12255 | 1.1.1.86 | |
| JGZ98_12255 | 1.1.1.86 | |
| JGZ98_12240 | 4.2.1.9 | |
| JGZ98_12235 | 2.6.1.42 | |
| JGZ98_12250 | 2.2.1.6 | |
| JGZ98_12255 | 1.1.1.86 | |
| JGZ98_12255 | 1.1.1.86 | |
| JGZ98_12240 | 4.2.1.9 | |
| JGZ98_12250 | 2.2.1.6 | |
| JGZ98_05240 | 2.3.3.13 | |
| JGZ98_12270 | 4.2.1.33 | |
| JGZ98_12260 | 1.1.1.85 | |
| | | gap |
| JGZ98_12235 | 2.6.1.42 | |
| JGZ98_00845 | 2.3.1.117 | |
| JGZ98_00845 | 2.3.1.117 | |
| JGZ98_16250 | 2.6.1.17 | |
| JGZ98_09540 or JGZ98_10820 | 3.5.1.18 | |
| JGZ98_14485 | 5.1.1.7 | |
| JGZ98_02420 | 4.1.1.20 | |
| JGZ98_00740 or JGZ98_01170 or JGZ98_09735 | 6.3.2.13 | |
| JGZ98_14800 | 6.3.2.10 | |
| JGZ98_00850 | 3.5.1.47 | |
| | 1.13.1.22 | gap |
| | 3.5.1.30 | gap |
| JGZ98_05090 | 2.6.1.48 | |
| JGZ98_05085 | 1.2.1.20 | |
| | 6.2.1.6 | gap |
| | 1.3.8.6 | gap |
| JGZ98_18100 or JGZ98_05595 or JGZ98_09265 | 4.2.1.17 | |
| JGZ98_08335 | 2.7.2.11 | |
| JGZ98_08330 | 1.2.1.41 | |
| JGZ98_16970 | 2.6.1.13 | |
| | 2.3.1.271 | gap |
| JGZ98_13615 | 4.3.1.12 | |
| JGZ98_08745 | 1.5.1.2 | |
| JGZ98_18125 | 1.5.1.2 | |
| | 1.14.11.2 | gap |
| | 1.5.5.3 | gap |
| JGZ98_15375 | 1.5.5.2 | |
| | 1.5.1.12 | |
| BS101_05700 or BS101_08640 or BS101_09610 or BS | 2.6.1.1 | |
| | 4.1.3.16 | gap |
| JGZ98_12340 | 4.1.1.19 | |
| JGZ98_12345 | 3.5.3.11 | |
| JGZ98_18575 | 2.6.1.82 | |
| JGZ98_00730 | 1.2.1.3 | |
| | 1.5.3.16 | gap |
| JGZ98_04590 | 2.4.2.17 | |
| JGZ98_04560 | 3.6.1.31 | |
| JGZ98_04560 | 3.5.4.19 | |
| JGZ98_04570 | 5.3.1.16 | |
| JGZ98_04045 | 4.2.1.10 | |

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| JGZ98_04580 | 4.2.1.19 |
| JGZ98_02680 | 2.6.1.9 |
| JGZ98_14060 | 3.1.3.15 |
| JGZ98_04585 | 1.1.1.23 |
| JGZ98_04585 | 1.1.1.23 |
| JGZ98_02680 | 2.6.1.9 |
| | 4.1.1.80 gap |
| JGZ98_08610 | 1.4.3.21 |
| | 1.2.1.5 1.2.1.53 |
| JGZ98_00015 | 1.14.14.9 |
| JGZ98_16600 | 2.6.1.1 |
| | 4.1.1.43 gap |
| | 1.2.1.39 gap |
| JGZ98_13320 | 6.2.1.30 |
| | 2.3.1.2.223 |
| JGZ98_18100 or JGZ98_05595 or JGZ98_09265 | 4.2.1.17 |
| JGZ98_06745 | 1.1.1.157 |
| JGZ98_05585 | 2.3.1.174 |
| JGZ98_07195 | 2.5.1.54 |
| JGZ98_02670 | 4.2.3.4 |
| JGZ98_04045 | 4.2.1.10 |
| JGZ98_03350 | 1.1.1.25 |
| JGZ98_03990 | 2.7.1.71 |
| JGZ98_02690 | 2.5.1.19 |
| JGZ98_02665 | 4.2.3.5 |
| JGZ98_09995 | 4.1.3.27 |
| JGZ98_10250 | 2.4.2.18 |
| JGZ98_10240 | 5.3.1.24 |
| JGZ98_10245 | 4.1.1.48 |
| JGZ98_10235 or JGZ98_10230 | 4.2.1.20 |
| JGZ98_10235 or JGZ98_10230 | 4.2.1.20 |
| JGZ98_09450 or JGZ98_02675 or JGZ98_03060 | 5.4.99.5 |
| JGZ98_03065 | 4.2.1.51 |
| JGZ98_02685 | 1.3.1.12 |
| | 2.6.1.57 |
| JGZ98_03065 | 4.2.1.51 |
| | 4.1.1.11 |
| JGZ98_09365 or JGZ98_02785 | 4.1.1.15 |
| JGZ98_18610 | 2.3.2.2 |
| | 1.8.1.3 gap |
| JGZ98_05670 | 2.7.7.4 |
| | 1.97.1.9 gap |
| JGZ98_12950 | 1.8.1.9 |
| JGZ98_16870 | 6.1.1.10 |
| JGZ98_03235 or JGZ98_14050 | |
| JGZ98_04645 | 2.5.1.48 |
| | 4.4.1.8 |
| JGZ98_05610 or JGZ98_05325 | 2.1.1.13 2.1.1.14 |
| | 3.5.5.4 gap |
| JGZ98_18610 | 2.3.2.2 |
| JGZ98_18610 | 2.3.2.2 |
| JGZ98_12130 | 3.5.1.2 |
| JGZ98_01295 | 6.3.2.9 |
| JGZ98_14760 | 5.1.1.1 |
| JGZ98_14805 | 6.3.2.4 |
| JGZ98_16580 or JGZ98_16590 or JGZ98_16585 | 3.5.2.9 |
| JGZ98_08125 | 3.4.19.13 |
| | 3.4.11.2 |

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| JGZ98_12405 or JGZ98_16695 | 1.11.1.9 | |
| | 1.8.1.7 | |
| | 2.5.1.18 | gap |
| JGZ98_18610 | 2.3.2.2 | |
| JGZ98_17030 | 3.4.11.1 | |
| | 2.3.1.80 | gap |
| JGZ98_00425 | 3.2.1.54 | |
| JGZ98_00425 | 3.2.1.133 | |
| | 2.4.1.19 | gap |
| JGZ98_00425 | 2.8.2.8 | |
| JGZ98_15620 | 5.4.2.10 | |
| JGZ98_13025 | 2.3.1.157 | |
| | 2.7.7.23 | |
| | 5.1.3.7 | gap |
| JGZ98_06535 or JGZ98_06690 | 2.5.1.7 | |
| JGZ98_16490 | 1.3.1.98 | |
| JGZ98_05530 or JGZ98_06590 or JGZ98_10410 or JG | 5.1.3.14 | |
| JGZ98_10425 | 1.1.1.336 | |
| | 4.4.1.11 | gap |
| JGZ98_05490 | 2.7.7.24 | |
| JGZ98_05485 | 4.2.1.46 | |
| JGZ98_01065 | 3.1.3.25 | |
| | 5.5.1.4 | gap |
| JGZ98_09470 | 6.3.2.8 | |
| | 6.3.2.7 | gap |
| JGZ98_14800 | 6.3.2.10 | |
| JGZ98_01290 | 2.7.8.13 | |
| | 2.4.1.227 | |
| JGZ98_03580 | 2.7.1.66 | |
| JGZ98_15745 or JGZ98_16375 | 3.6.1.27 | |
| JGZ98_01925 | 2.5.1.31 | |
| | | gap |
| JGZ98_00730 | 1.2.1.3 | |
| | 1.1.1.72 | gap |
| JGZ98_16435 | 2.7.1.30 | |
| JGZ98_12300 | 2.3.1.275 | |
| JGZ98_01565 | 2.3.1.274 | |
| JGZ98_12030 | 2.7.1.107 | |
| JGZ98_02605 | 1.1.1.94 | |
| JGZ98_01065 | 3.1.3.25 | |
| | 3.1.4.3 | gap |
| JGZ98_02195 | 1.1.5.3 | |
| JGZ98_16105 | 2.7.7.39 | |
| JGZ98_01930 | 2.7.7.41 | |
| JGZ98_02105 | 2.7.8.5 | |
| | 3.1.3.27 | gap |
| JGZ98_03335 | 4.1.1.65 | |
| | 3.1.1.32 | gap |
| JGZ98_10255 or JGZ98_09665 | 3.1.1.5 | |
| JGZ98_01180 or JGZ98_15850 | 3.1.4.46 | |
| JGZ98_02735 | 3.1.4.46 | |
| JGZ98_13950 or JGZ98_13955 or JGZ98_04095 or JG | 6.4.1.2 2.1.3.15 | |
| JGZ98_00940 | 2.3.3.9 | |
| JGZ98_09425 or JGZ98_14030 | 6.2.1.1 | |
| | 1.2.5.1 | |
| JGZ98_06840 | 5.3.2.6 | |
| | 1.2.1.85 | gap |
| JGZ98_16480 | 1.13.11.2 | |

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| | 4.2.1.32 | gap |
| JGZ98_05575 | 1.1.1.93 | |
| JGZ98_18100 or JGZ98_05595 or JGZ98_09265 | 4.2.1.17 | |
| | 4.3.1.6 | gap |
| JGZ98_05090 | 2.6.1.19 | |
| | 1.3.8.1 | |
| JGZ98_04240 | 2.3.1.168 | |
| JGZ98_04230 | 1.2.4.4 | |
| JGZ98_04230 | 1.2.4.4 | |
| JGZ98_16175 | 1.1.1.27 | |
| JGZ98_01675 | 4.1.3.30 | |
| | 4.2.1.99 | gap |
| JGZ98_01670 | 4.2.1.79 | |
| | 2.3.3.5 | gap |
| | 2.1.3.1 | gap |
| JGZ98_09225 | 1.3.5.1 | |
| JGZ98_05605 | 2.8.3.8 | |
| | 1.3.1.86 | gap |
| JGZ98_14255 | 1.1.1.35 | |
| JGZ98_02140 | 1.2.7.11 | |
| JGZ98_14580 | 1.5.1.3 | |
| JGZ98_11715 | 6.3.4.3 | |
| JGZ98_05640 | 3.5.1.10 | |
| JGZ98_04115 | 3.5.4.9 | |
| JGZ98_01480 or JGZ98_15355 | 2.1.2.9 | |
| JGZ98_03905 | 6.3.3.2 | |
| JGZ98_15350 | 1.5.1.20 | |
| JGZ98_12280 | 4.2.1.3 | |
| JGZ98_02135 | 1.2.7.3 | |
| JGZ98_11675 | 4.1.99.17 | |
| JGZ98_13310 | 2.7.1.49 | |
| | 2.7.4.7 | |
| JGZ98_13315 | 2.5.1.3 | |
| JGZ98_01505 | 3.1.3.1 3.1.3.100 | |
| JGZ98_01515 | 2.7.6.2 | |
| JGZ98_11380 | 2.7.4.3 | |
| JGZ98_08495 | 2.7.7.73 | |
| JGZ98_05065 | 2.8.1.4 | |
| JGZ98_04135 | 2.2.1.7 | |
| JGZ98_08500 | 2.8.1.10 | |
| JGZ98_08515 | 5.3.99.10 | |
| JGZ98_13315 | 2.5.1.3 | |
| JGZ98_13305 | 2.7.1.50 | |
| JGZ98_13300 | 3.5.99.2 | |
| JGZ98_10390 | 4.1.99.12 | |
| JGZ98_10390 | 3.5.4.25 | |
| JGZ98_10400 | 3.5.4.26 | |
| JGZ98_10400 | 1.1.1.193 | |
| JGZ98_00435 or JGZ98_01995 or JGZ98_06090 | 3.1.3.104 | |
| JGZ98_10385 | 2.5.1.78 | |
| JGZ98_10395 | 2.5.1.9 | |
| JGZ98_01995 or JGZ98_06090 | 2.7.1.26 | |
| JGZ98_01995 or JGZ98_06090 | 2.7.7.2 | |
| JGZ98_17285 or JGZ98_18455 | 1.5.1.38 | |
| | 1.13.11.79 | gap |
| JGZ98_06910 | 2.7.1.35 | |
| | 1.4.3.5 | gap |
| JGZ98_06910 | 2.7.1.35 | |

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| JGZ98_16675 or JGZ98_16670 or JGZ98_16670 | 4.3.3.6 | |
| JGZ98_16050 or JGZ98_16405 | 4.2.3.1 | |
| JGZ98_06910 | 2.7.1.35 | |
| | 1.4.3.5 | gap |
| | | gap |
| | | gap |
| JGZ98_15105 | 1.4.3.16 | |
| JGZ98_15095 | 2.5.1.72 | |
| JGZ98_06595 or JGZ98_01380 | 2.4.2.9 | |
| JGZ98_15395 | 6.3.4.21 | |
| JGZ98_04105 | 3.1.3.5 | |
| | 2.4.2.1 | |
| JGZ98_03360 | 2.7.7.18 | |
| JGZ98_15400 | 6.3.1.5 | |
| JGZ98_00610 | 2.7.1.23 | |
| JGZ98_03360 | 2.7.7.18 | |
| JGZ98_02110 | 3.5.1.42 | |
| | 2.4.2.1 | |
| JGZ98_04105 | 3.1.3.5 | |
| JGZ98_02775 | 2.1.2.11 | |
| JGZ98_01250 | 1.1.1.169 | |
| JGZ98_02780 | 6.3.2.1 | |
| JGZ98_11755 or JGZ98_13150 | 2.7.1.33 | |
| JGZ98_01465 | 6.3.2.5 | |
| JGZ98_01465 | 4.1.1.36 6.3.2.5 | |
| JGZ98_01210 | 2.7.7.3 | |
| JGZ98_13885 | 2.7.1.24 | |
| JGZ98_14770 | 2.7.8.7 | |
| JGZ98_17605 | 2.8.1.6 | |
| JGZ98_02770 | 6.3.4.15 | |
| JGZ98_02770 | 6.3.4.15 | |
| JGZ98_04670 | 6.3.1.20 | |
| JGZ98_14375 | 2.8.1.8 | |
| JGZ98_04015 | 2.3.1.181 | |
| JGZ98_06865 | 2.3.1.204 | |
| JGZ98_08285 | 4.2.3.12 4.1.2.50 | |
| JGZ98_08280 | 4.3.99.3 | |
| JGZ98_05635 | 6.3.4.20 | |
| JGZ98_05400 | 1.7.1.13 | |
| JGZ98_10495 | 3.1.3.1 | |
| JGZ98_02630 or JGZ98_17810 | 3.5.4.16 | |
| JGZ98_02630 or JGZ98_17810 | 3.5.4.16 | |
| JGZ98_02630 or JGZ98_17810 | 3.5.4.16 | gap |
| JGZ98_02630 or JGZ98_17810 | 3.5.4.16 | gap |
| JGZ98_02630 or JGZ98_17810 | 3.5.4.16 | gap |
| | 3.1.3.1 | gap |
| JGZ98_13185 | 4.1.2.25 | |
| JGZ98_13190 | 2.7.6.3 | |
| JGZ98_13180 | 2.5.1.15 | |
| JGZ98_13175 | 4.1.3.38 | |
| JGZ98_13165 | 2.6.1.85 | |
| JGZ98_13180 | 2.5.1.15 | |
| JGZ98_16850 | 6.3.2.12;6.3.2.17 | |
| JGZ98_17885 | 4.1.99.22 | |
| JGZ98_17925 | 4.6.1.17 | |
| JGZ98_17910 | 2.8.1.12 | |
| JGZ98_17920 | 2.7.7.75 | |
| JGZ98_17905 | 2.10.1.1 | |

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|---|---|
| JGZ98_17880 | 2.7.7.76 |
| JGZ98_11160 | 6.1.1.17 |
| JGZ98_16900 | 1.2.1.70 |
| JGZ98_16875 | 5.4.3.8 |
| JGZ98_16880 | 4.2.1.24 |
| JGZ98_16890 | 2.5.1.61 |
| JGZ98_03200 or JGZ98_16885 | 4.2.1.75 |
| JGZ98_04725 | 4.1.1.37 |
| JGZ98_03450 or JGZ98_04830 | 1.3.98.3 |
| JGZ98_04715 or JGZ98_15340 | 1.3.3.4 1.3.3.15 |
| JGZ98_04720 | 4.99.1.1 4.99.1.9 |
| JGZ98_06870 | 1.3.98.5 |
| JGZ98_10145 or JGZ98_15180 | 2.1.1.107 4.2.1.75 |
| JGZ98_10150 | 1.3.1.76 4.99.1.4 |
| JGZ98_13225 | |
| JGZ98_10195 | 4.99.1.3 |
| JGZ98_10170 | 2.1.1.130 2.1.1.151 |
| JGZ98_10200 | 2.1.1.131 |
| JGZ98_10160 | 3.7.1.12 |
| JGZ98_10165 | 2.1.1.133 2.1.1.271 |
| JGZ98_10190 | 1.3.1.54 1.3.1.106 |
| JGZ98_10180 | 2.1.1.195 |
| JGZ98_10175 | 2.1.1.132 2.1.1.289 2.1.1.196 |
| JGZ98_10185 | 5.4.99.61 5.4.99.60 |
| JGZ98_10155 | 6.3.5.9 6.3.5.11 |
| JGZ98_06770 or JGZ98_10135 | 2.5.1.17 |
| JGZ98_10130 | 6.3.5.10 |
| JGZ98_06790 | 2.7.1.156 2.7.7.62 |
| JGZ98_06785 | 2.7.8.26 |
| JGZ98_05700 | 2.4.2.21 |
| JGZ98_01935 | 1.1.1.267 |
| JGZ98_11150 | 2.7.7.60 |
| JGZ98_12990 | 2.7.1.148 |
| JGZ98_11155 | 4.6.1.12 |
| JGZ98_03850 | 1.17.7.1 |
| | 1.17.1.2 gap |
| JGZ98_03715 | 1.17.1.4 |
| JGZ98_03715 | 1.17.7.4 gap |
| | 1.17.1.2 gap |
| JGZ98_04130 | 2.5.1.1 2.5.1.10 2.5.1.29 |
| | 2.5.1.10 gap |
| JGZ98_02640 or JGZ98_02650 | 2.5.1.30 |
| | 1.7.7.2 gap |
| JGZ98_06300 | 4.2.1.1 |
| JGZ98_18470 or JGZ98_02515 | 1.13.12.16 |
| JGZ98_05675 | 1.8.4.8 |
| JGZ98_15165 or JGZ98_15160 | 1.8.1.2 |
| JGZ98_05840 | 1.8.5.4 |
| JGZ98_04645 | 2.5.1.48 |
| JGZ98_17595 | 4.4.1.2 |
| | 2.8.2.4 |
| JGZ98_16690 | 1.1.1.205 |
| JGZ98_17510 | 6.3.5.2 |
| | 2.8.2.4 |
| JGZ98_11905 or JGZ98_13710 | 2.5.1.49 |
| JGZ98_13100 | 3.1.3.29 |
| JGZ98_00250 | 2.7.7.43 |
| JGZ98_05540 or JGZ98_16045 | 4.2.1.115 5.1.3.- |
| JGZ98_18040 | 3.1.3.18 |

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|---|---|
| JGZ98_18645 or JGZ98_10500 or JGZ98_07210 | 1.1.1.284 1.1.1.1 |
| JGZ98_10755 | 1.5.1.7 |
| JGZ98_06795 | 4.1.1.18 |
| | 1.2.1.19 |
| JGZ98_10505 | 2.6.1.113 |
| JGZ98_10760 | 4.1.1.96 |
| JGZ98_16450 | 2.3.1.53 2.3.1.- |
| JGZ98_10905 | 3.5.1.4 |
| JGZ98_04550 or JGZ98_18595 | 1.8.1.9 |
| JGZ98_14330 | 2.8.1.7 4.4.1.16 |
| JGZ98_14965 | 3.5.1.11 |
| JGZ98_07125 or JGZ98_07120 | 4.3.1.7 |
| JGZ98_03930 | 3.1.2.6 |
| JGZ98_09340 | 1.1.2.4 |
| JGZ98_04920 or JGZ98_12455 | 1.1.1.283 1.1.1.- |
| JGZ98_00105 or JGZ98_13915 | 1.1.1.38 |
| JGZ98_02755 | 4.2.3.3 |
| JGZ98_00935 | 4.1.3.1 |
| JGZ98_14275 | |
| JGZ98_10845 | 4.1.1.2 |
| JGZ98_01240 | 4.1.1.94 4.1.1.- |
| JGZ98_15100 | 2.4.2.19 |
| JGZ98_17595 | 4.4.1.1 4.4.1.2 |
| JGZ98_05470 or JGZ98_16000 | 1.11.1.6 |
| JGZ98_00820 | 2.7.4.1 |
| JGZ98_06055 or JGZ98_08310 or JGZ98_14405 | 7.1.1.2 |
| JGZ98_01135 or JGZ98_01130 or JGZ98_01125 or JG | 7.1.1.9 |
| JGZ98_01015 or JGZ98_01110 or JGZ98_01010 or JG | 7.1.1.5 |
| JGZ98_09710 or JGZ98_12025 or JGZ98_09715 or JG | 7.1.1.7 |
| JGZ98_06560 or JGZ98_06550 | 7.1.2.2 7.2.2.1 |
| JGZ98_16455 | 3.6.1.1 |
| JGZ98_15175 | 4.99.1.4 |
| JGZ98_01115 or JGZ98_08735 | 2.5.1.141 |
| JGZ98_01580 | |
| JGZ98_02645 | 2.1.1.163 2.1.1.201 |
| JGZ98_02200 | 2.5.1.75 |
| JGZ98_05705 | 3.3.2.1 6.3.2.14 |
| JGZ98_05715 | 1.3.1.28 |
| JGZ98_05745 | 6.3.2.14 2.7.7.58 |
| JGZ98_15600 | 1.1.1.385 |
| JGZ98_15595 | 6.3.2.49 |
| | 1.2.1.76 gap |
| H2[c] + 7 NADH[c] + AMP[c] + PPI[c] + 8 H[c] | 1.3.99.- gap |
| | 3.1.4.46 gap |
| | 3.1.3.4 gap |
| JGZ98_14865 | 2.7.8.- |
| JGZ98_05940 | 1.3.1.101 1.3.7.11 |
| JGZ98_10930 | 1.7.1.7 |
| JGZ98_13970 | 3.1.3.7 3.1.13.3 |
| JGZ98_10245 | 4.1.1.48 |
| JGZ98_13610 | 3.5.4.44 |
| | 2.3.1.182 gap |
| JGZ98_04595 | |
| JGZ98_16025 | 2.4.1.87 |
| JGZ98_06035 | 3.1.3.82 3.1.3.83 |
| JGZ98_05535 | 1.1.1.367 |
| JGZ98_17015 or JGZ98_06830 | 2.4.1.129 3.4.16.4 |
| JGZ98_07440 | 3.5.1.28 3.2.1.96 |

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|---|---|---|---|
| JGZ98_00120 | 2.7.8.33 2.7.8.35 | | |
| JGZ98_04095 or JGZ98_04100 | 6.4.1.2 6.3.4.14 | | |
| JGZ98_03995 | 2.1.2.10 | | |
| JGZ98_08510 | 1.4.3.19 | | |
| JGZ98_10495 | 3.1.3.1 | | |
| JGZ98_11765 | 2.5.1.21 | | |
| JGZ98_14395 | 3.1.3.41 | | |
| JGZ98_13380 | 3.8.1.2 | | |
| JGZ98_00120 | 2.7.8.33 | uniprot | |
| JGZ98_00505 | 2.3.1.180 | uniprot | |
| JGZ98_00605 | 2.7.6.5 | uniprot | |
| JGZ98_03870 | 1.15.1.1 | uniprot | |
| JGZ98_03235 | 2.8.1.7 | uniprot | |
| JGZ98_00515 or JGZ98_00975 | 6.1.1.2 3.5 | uniprot | |
| JGZ98_01000 | 1.1.1.184 | uniprot | |
| JGZ98_01065 | 3.1.3.25 3. | uniprot | |
| JGZ98_01365 | 6.1.1.5 | uniprot | |
| JGZ98_01465 | 4.1.1.36 6. | uniprot | |
| JGZ98_01495 | 3.1.3.16 | uniprot | |
| JGZ98_01500 | 2.7.11.1 | uniprot | |
| JGZ98_01705 | 2.1.1.74 | uniprot | |
| JGZ98_01815 or JGZ98_01860 | 3.1.1.61 3. | uniprot | |
| JGZ98_01880 | 3.5.1.44 | uniprot | |
| JGZ98_01945 | 6.1.1.15 | uniprot | |
| JGZ98_02005 | 2.7.7.8 | uniprot | |
| JGZ98_02660 | 2.1.1.80 | uniprot | |
| JGZ98_02765 | 2.7.7.72 | uniprot | |
| JGZ98_03095 | 2.4.99.17 | uniprot | |
| JGZ98_03170 | 6.1.1.21 | uniprot | |
| JGZ98_03175 | 6.1.1.12 | uniprot | |
| JGZ98_03255 | 6.1.1.7 | uniprot | |
| JGZ98_03410 | 1.11.1.24 | uniprot | |
| JGZ98_03670 | 6.1.1.14 | uniprot | |
| JGZ98_04115 | 1.5.1.5 3.5 | uniprot | |
| | 6.2.1.3 | BS101_16615 | modelSEED |
| | | BS101_09 KAAS | modelSEED |
| | 2.3.1.16 | | |
| | 1.1.1.35 | peg.601 | modelSEED |
| | 4.2.1.17 | BS101_14 KAAS | modelSEED |
| | 1. 3. 1. 44 | | |
| | | gap filling for growth | |

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|---|---|
| JGZ98_12440 and JGZ98_12435 | |
| JGZ98_00540 | 3.A.1.5.27 |
| JGZ98_01845 or JGZ98_06315 | 1.A.104.1.1 1.A.30.1.3 1.A.30.1.4 |
| JGZ98_04875 or JGZ98_00620 | 1.A.112.2.2 1.A.26.1.2 |
| JGZ98_05720 | 2.A.1.15.7 |
| JGZ98_06350 | 2.A.1.26.3 |
| JGZ98_00115 | 2.A.26.1.1 |
| JGZ98_00115 | 2.A.26.1.10 |
| JGZ98_00115 | 2.A.26.1.2 |
| JGZ98_00115 | 2.A.26.1.3 |
| JGZ98_04640 | 2.A.3.1.1 |
| JGZ98_05095 | 2.A.3.1.2 |
| JGZ98_00955 | 2.A.38.4.2 |
| JGZ98_06585 | 1.A.77.3.4 |
| JGZ98_06275 or JGZ98_04760 or JGZ98_06955 | 2.A.88.3.1 2.A.88.4.1 2.A.88.9.1 |
| JGZ98_01045 | 2.A.122.1.1 2.A.122.1.5 2.A.122.1.7 |
| | 1.A.33.1.5 |

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| | 2.3.1.39 lump reaction |
| | (2.3.1.41;2.3.1.179):1.1.1.100:1.3.1.9:4.2.1.- |
| | (2.3.1.41;2.3.1.179):1.1.1.100:1.3.1.9:4.2.1.- |
| JGZ98_12110 | (2.3.1.41;2.3.1.179):1. lump reaction |

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| JGZ98_09200 | (2.3.1.41;2.3.1.179):1.1.1.100:1.3.1.9:4.2.1.- | |
| JGZ98_01570 | 2.3.1.51 | |
| ] + 6 ACP[c] + 6 H2O[c] | | |
| 2[c] + 6 ACP[c] + 6 H2O[c] | 2.7.8.- | |
| ] + 7 ACP[c] + 7 H2O[c] | | |
| ] + 7 ACP[c] + 7 H2O[c] | | |
| 2[c] + 7 ACP[c] + 7 H2O[c] | | |
| | 1.3.1.31 | |
| > AGLY3P[c] + ACP[c] | | |
| JGZ98_02590 | | |
| H[c] | 2.7.8.20 | |
| P[c] + 45 CMP[c] + GTA2[c] + 45 PPI[c] + UDP[c] + U | 2.7.1.48 | |
| + 46 UDP[c] + UMP[c] + 91 H[c] | | gap |
| | 1.2.1.21 | |
| | 1.1.1.29 | |
| | | gap |
| + LIPO3[c] + 24 PPI[c] + 48 H[c] | | gap |
| | 1.5.1.3 | gap filling for growth |
| | | gap filling for growth |
| | | gap filling for growth |
| | | gap filling for growth |
| | | gap filling for growth |
| | | gap filling for growth |
| | | gap filling for growth |
| | | gap filling for growth |
| | | gap filling for growth |
| | 6.3.4.14 | gap |
| | 1.2.4.2 | gap |
| | 1.1.1.95 | gap |
| | 2.3.1.89 | gap |
| | 3.4.11.1 | gap |
| | 3.5.4.19 | gap |
| | 4.1.1.36 | gap |
| | 2.4.2.8 | gap |
| | 2.3.1.157 | gap |
| | 3.5.1.28 | gap |
| | 1.8.4.11/1 | gap |
| | 2.7.1.26 | gap |
| | 2.3.1.31 | gap |
| | 3.6.1.23 | gap |
| P[c] + 2 ACP[c] + PMEACP[c] | 4.2.1.59 | gap |

7726 GTP[c] + 0.04792 CTP[c] + 0.05183 UTP[c] + 0.00040 GLY[c] + 0.00026 ALA[c] + 0.00030 VA

L[c] + 0.00034 LEU[c] + 0.00026 ILE[c] + 0.00021 SER[c] + 0.00018 THR[c] + 0.00017 PHE[c] + 0

).00011 TYR[c] + 0.00005 TRP[c] + 0.00006 CYS[c] + 0.00011 MET[c] + 0.00031 LYS[c] + 0.0001

9 ARG[c] + 0.00008 HIS[c] + 0.00014 ASP[c] + 0.00025 GLU[c] + 0.00014 ASN[c] + 0.00025 GLN[

[c] + 0.00016 PRO[c] + 0.0293 PG[c] + 0.0833 PE[c] + 0.00022 DAGL[c] + 0.0029 CL[c] + 0.12347

PEPG[c] + 0.00439 GTA[c] + 0.00284 GTA2[c] + 0.00220 GTA3[c] + 0.00378 MGTA[c] + 0.6886(

) K[c] + 0.00336 FE3[c] + 0.09920 MG[c] + 0.00312 CA[c] + 0.00023 MQL8[c] + 0.00036 FTHF[c]

+ 0.01567 NAD[c] + 0.00452 AMP[c] + 0.00099 CMP[c] + 0.00091 NADP[c] + 0.00053 CTP[c] + 0

.00051 GMP[c] + 0.00042 GTP[c] + 0.00025 CDP[c] + 0.00020 NADPH[c] + 0.00019 GDP[c] + 105

; H2O[c] -> 0.00089 PPI[c] + 105 H[c] + 0.01402 PI[c] + 0.00249 ADP[c]