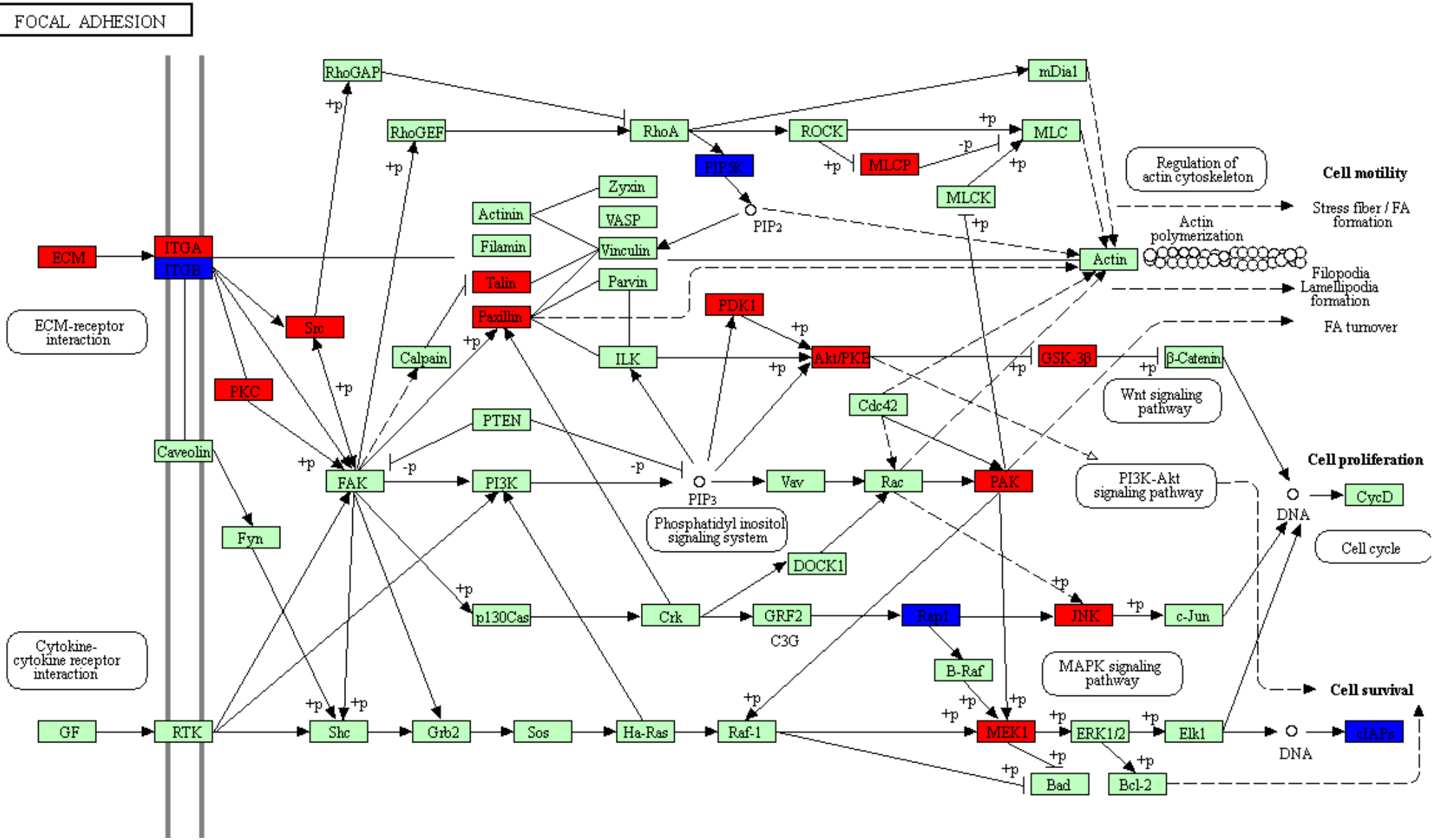
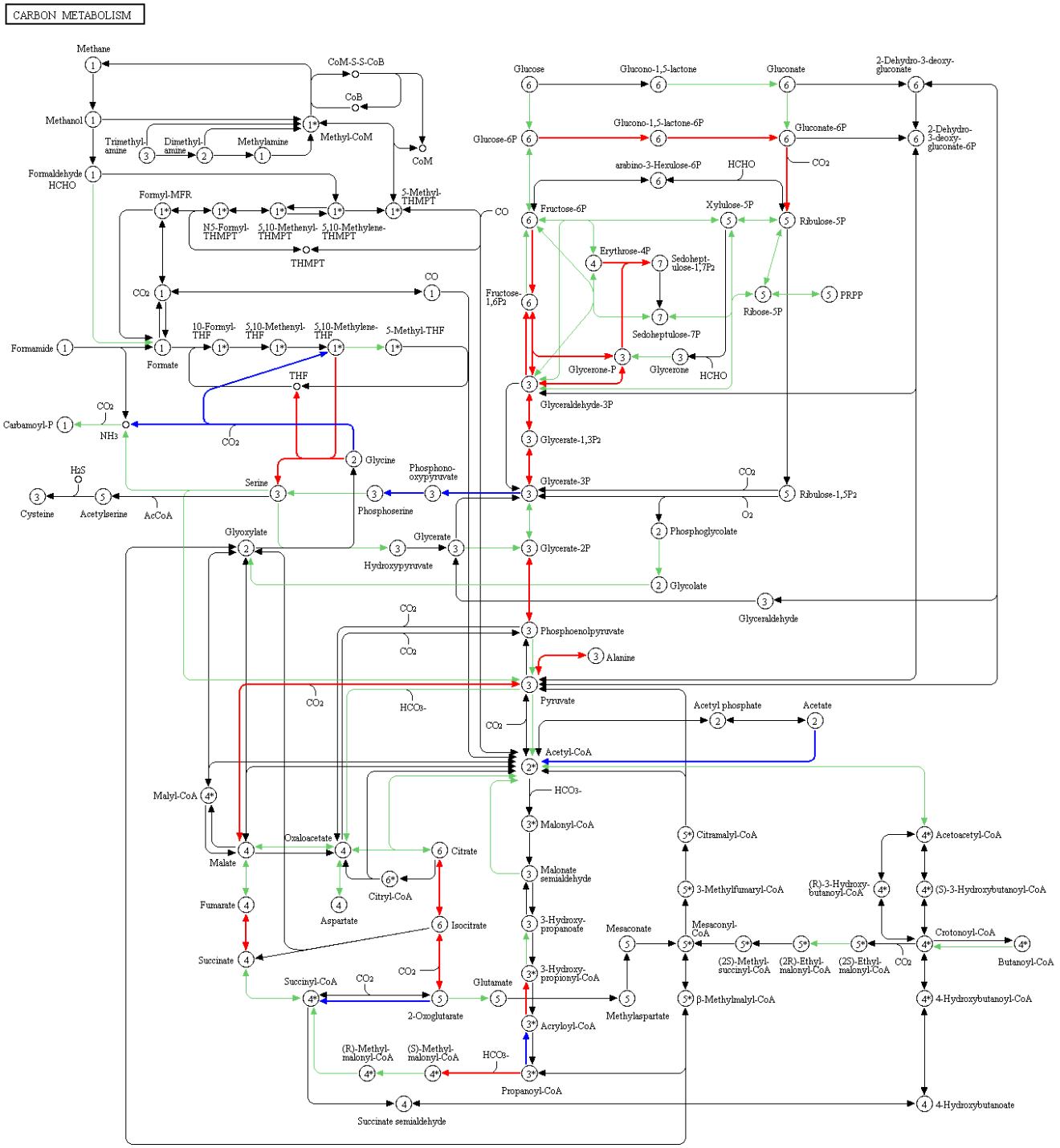
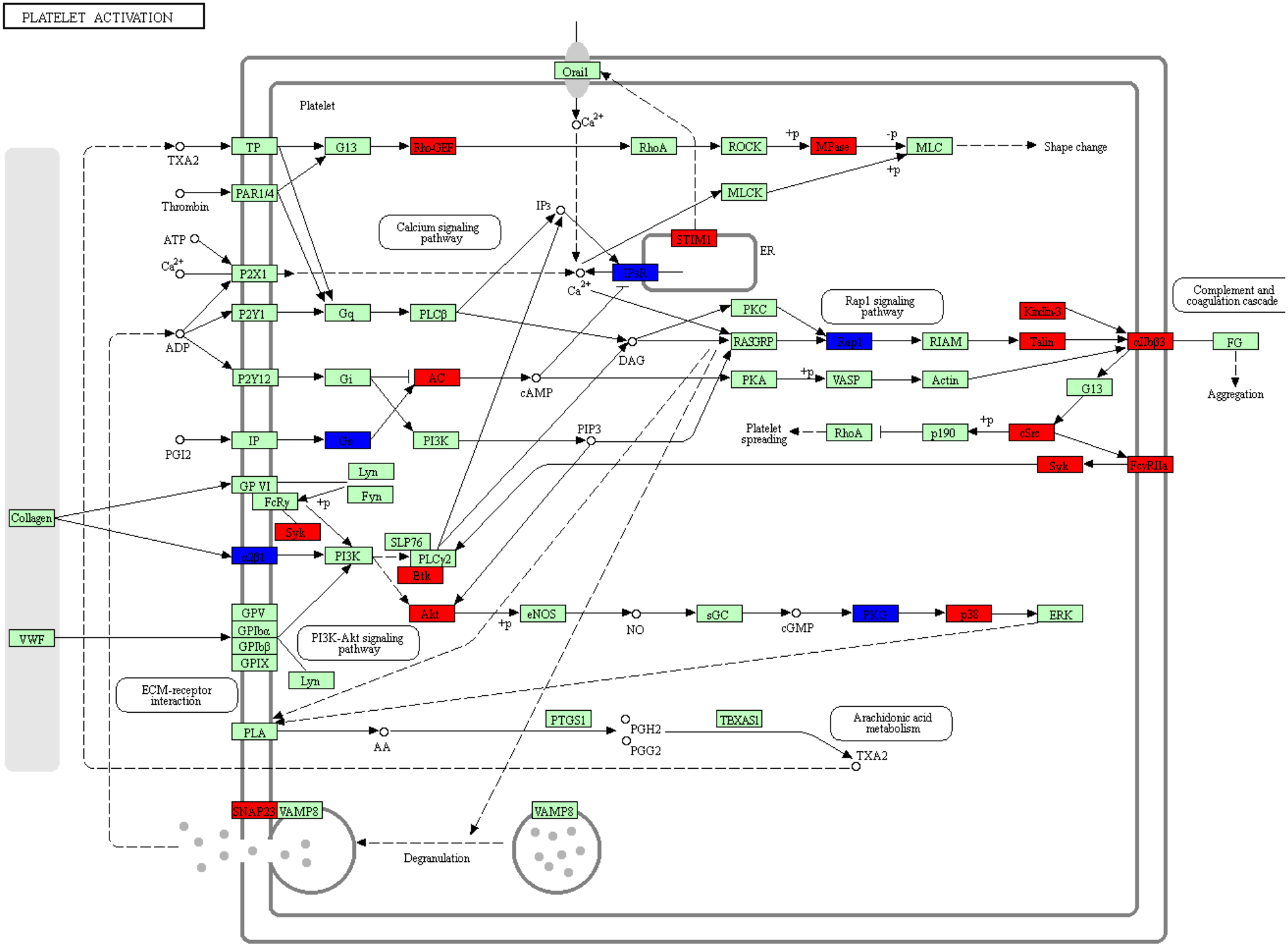
Supplemental Figure 1

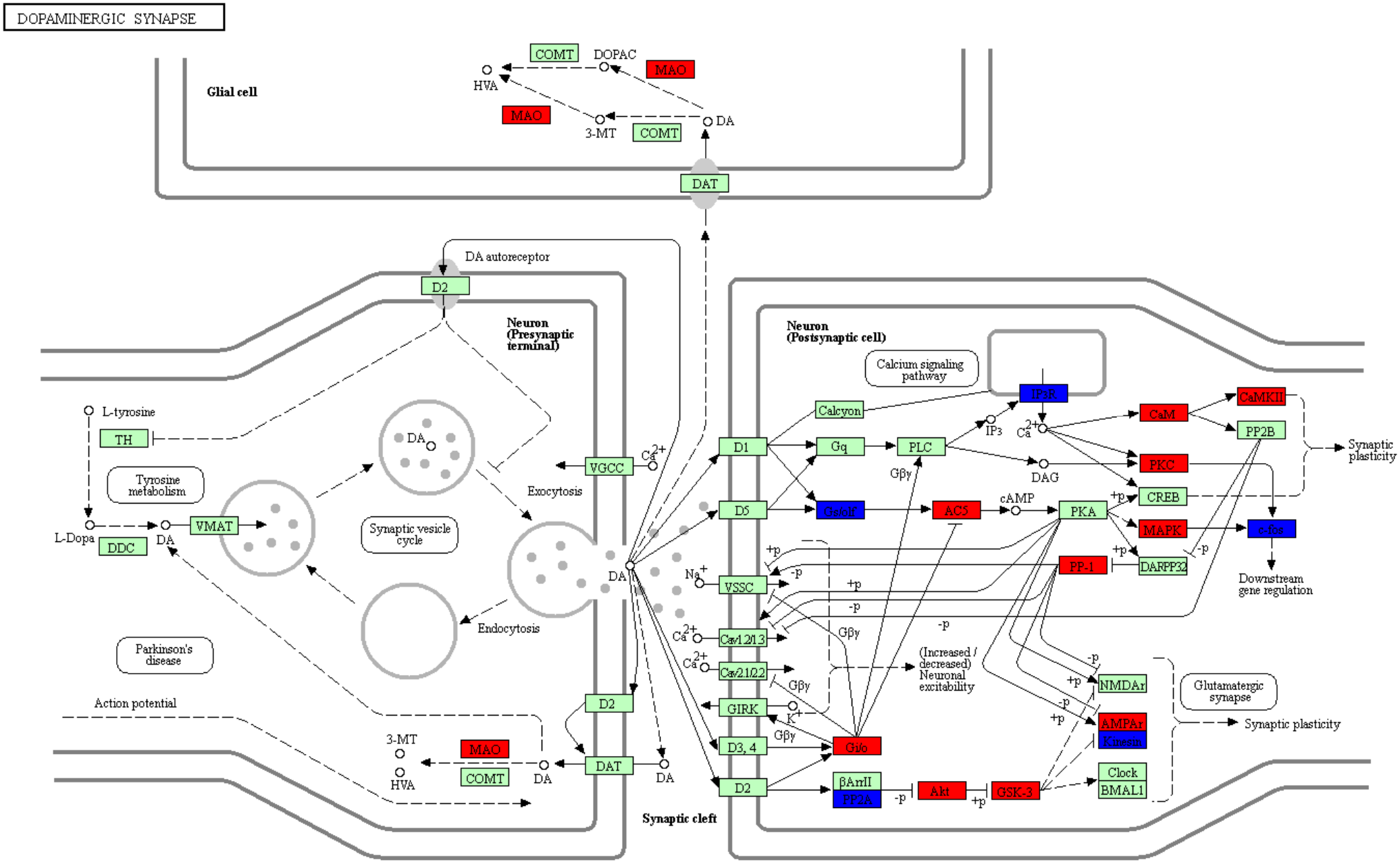
52 statistically significant KEGG pathways enriched with 1088 overlapped molecules (DEGs; proteins)

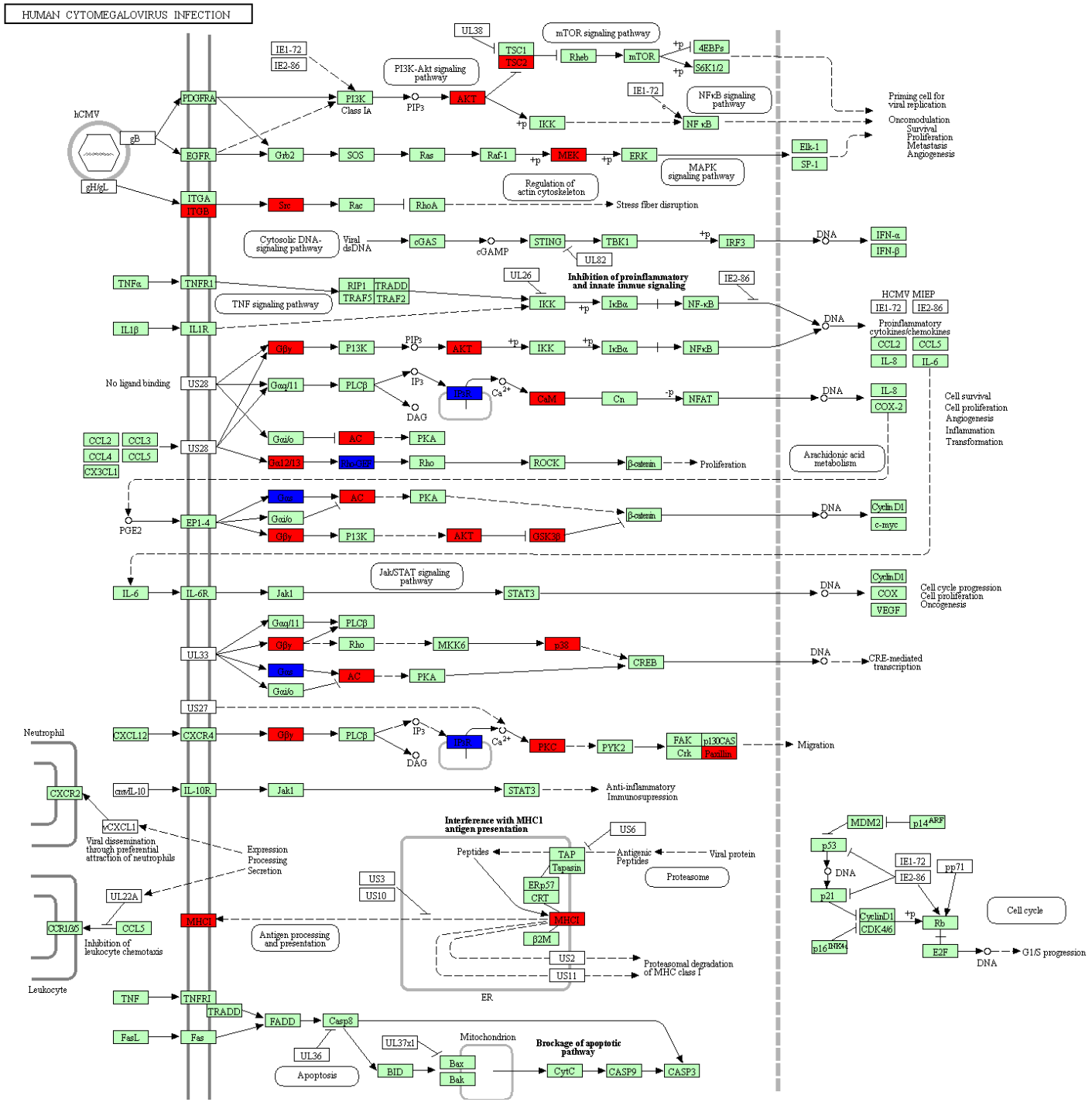
1. Focal adhesion
2. Carbon metabolism
3. Platelet activation
4. Dopaminergic synapse
5. Human cytomegalovirus infection
6. Proteoglycans in cancer
7. Regulation of actin cytoskeleton
8. cGMP-PKG signaling pathway
9. Retrograde endocannabinoid signaling
10. Biosynthesis of amino acids
11. Thyroid hormone signaling pathway
12. Adrenergic signaling in cardiomyocytes
13. ECM-receptor interaction
14. Relaxin signaling pathway
15. Insulin signaling pathway
16. PPAR signaling pathway
17. Neurotrophin signaling pathway
18. Estrogen signaling pathway
19. Dilated cardiomyopathy (DCM)
20. Hypertrophic cardiomyopathy (HCM)
21. Circadian entrainment
22. Glucagon signaling pathway
23. Glycolysis / Gluconeogenesis
24. Phagosome
25. Salivary secretion
26. Aldosterone synthesis and secretion
27. Pancreatic secretion
28. Inflammatory mediator regulation of TRP channels
29. C-type lectin receptor signaling pathway
30. Cholinergic synapse
31. Gap junction
32. GnRH signaling pathway
33. HIF-1 signaling pathway
34. Fatty acid metabolism
35. Arrhythmogenic right ventricular cardiomyopathy (ARVC)
36. Small cell lung cancer
37. Adipocytokine signaling pathway
38. Amphetamine addiction
39. Gastric acid secretion
40. Glycine, serine and threonine metabolism
41. Arginine and proline metabolism
42. Ferroptosis
43. Cysteine and methionine metabolism
44. Pyruvate metabolism
45. Fatty acid degradation
46. Biosynthesis of unsaturated fatty acids
47. Citrate cycle (TCA cycle)
48. Pentose phosphate pathway
49. Glyoxylate and dicarboxylate metabolism
50. Mucin type O-glycan biosynthesis
51. Propanoate metabolism
52. Proximal tubule bicarbonate reclamation


FOCAL ADHESION
RhoGAP
RhoGEF
RhoA
ROCK
mDia1
MLC
MLCP
MLCK
PIP5K
PIP2
Regulation of actin cytoskeleton
Cell motility
Stress fiber / FA formation
Actin polymerization
Actin
Filopodia Lamellipodia formation
FA turnover
Zyxin
VASP
Vinculin
Parvin
Actinin
Filamin
Talin
Paxillin
ILK
PDK1
Akt/PKB
GSK-3β
β-Catenin
Wnt signaling pathway
Cdc42
PI3K-Akt signaling pathway
Cell proliferation
CycD
Cell cycle
DNA
ECM
ITGA
ITGB
ECM-receptor interaction
Src
PKC
Calpain
Caveolin
Fyn
FAK
PTEN
PI3K
PIP3
Phosphatidyl inositol signaling system
Vav
Rac
PAK
DOCK1
p130Cas
Crk
GRF2
C3G
Rap1
JNK
c-Jun
B-Raf
MAPK signaling pathway
Cytokine-cytokine receptor interaction
GF
RTK
Shc
Grb2
Sos
Ha-Ras
Raf-1
MEK1
ERK1/2
Elk1
Cell survival
cIAPs
Bad
Bcl-2
+p
-p

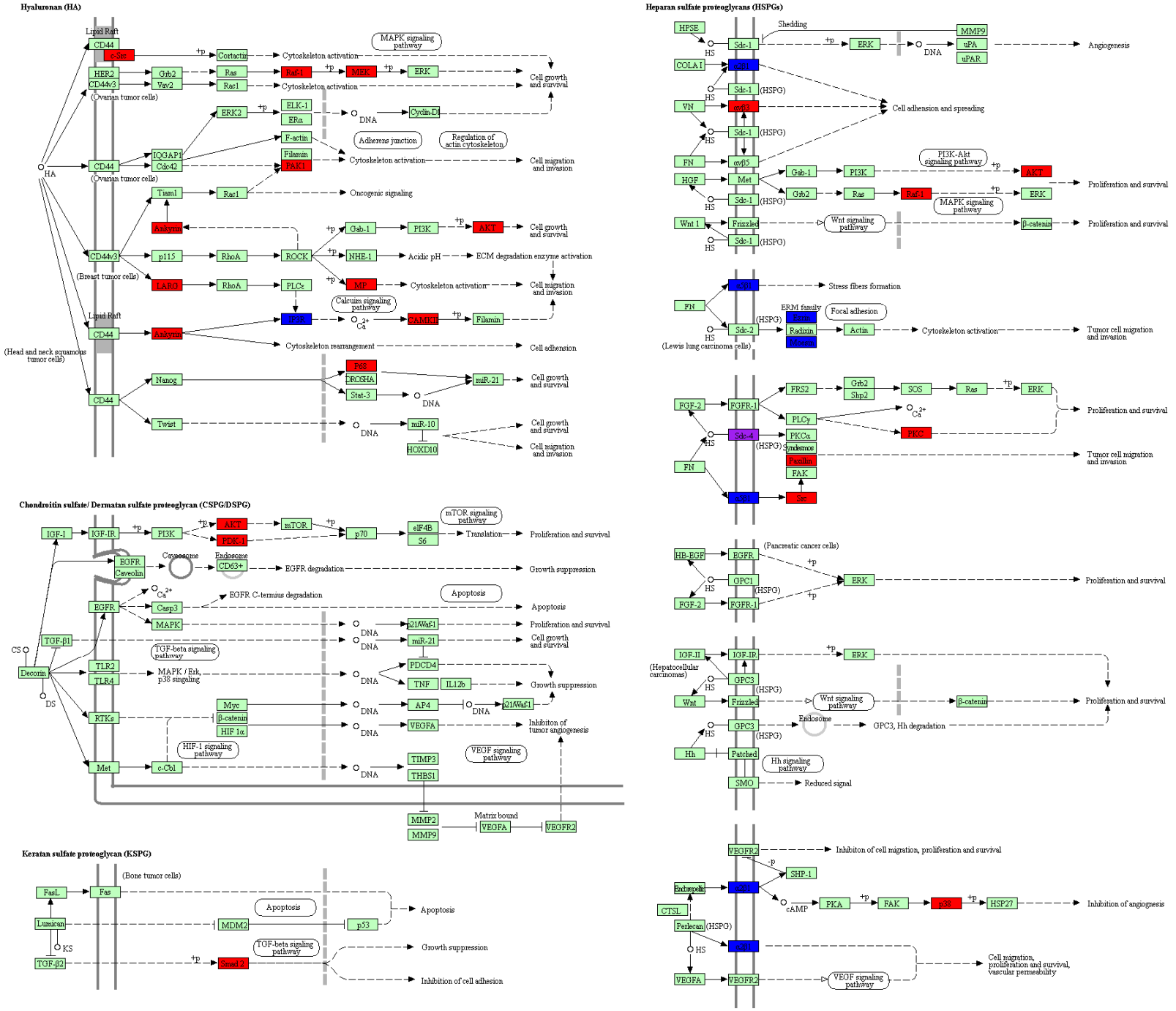

CARBON METABOLISM
Methane
CoM-S-S-CoB
CoB
Methanol
Trimethyl-amine
Dimethyl-amine
Methylamine
Methyl-CoM
CoM
Formaldehyde
HCHO
Formyl-MFR
5-Methyl-THMPT
N5-Formyl-THMPT
5,10-Methenyl-THMPT
5,10-Methylene-THMPT
THMPT
CO
CO2
10-Formyl-THF
5,10-Methenyl-THF
5,10-Methylene-THF
5-Methyl-THF
Formamide
Formate
THF
Carbamoyl-P
NH3
Glycine
H2S
Cysteine
Acetylserine
AcCoA
Serine
Phosphono-oxypyruvate
Phosphoserine
Glyoxylate
Glycerate
Hydroxypyruvate
Glucose
Glucono-1,5-lactone
Gluconate
2-Dehydro-3-deoxy-gluconate
Glucose-6P
Glucono-1,5-lactone-6P
Gluconate-6P
2-Dehydro-3-deoxy-gluconate-6P
arabino-3-Hexulose-6P
HCHO
Fructose-6P
Xylulose-5P
Ribulose-5P
Erythrose-4P
Sedohept-ulose-1,7P2
Fructose-1,6P2
Ribose-5P
PRPP
Sedoheptulose-7P
Glycerone-P
Glycerone
Glyceraldehyde-3P
Glycerate-1,3P2
Glycerate-3P
Ribulose-1,5P2
O2
Phosphoglycolate
Glycerate-2P
Glycolate
Glyceraldehyde
Phosphoenolpyruvate
Alanine
Pyruvate
Acetyl phosphate
Acetate
Acetyl-CoA
HCO3-
Malyl-CoA
Malonyl-CoA
Oxaloacetate
Citrate
Malate
Malonate semialdehyde
Citryl-CoA
Fumarate
Aspartate
3-Hydroxy-propanoate
Isocitrate
Succinate
Succinyl-CoA
3-Hydroxy-propionyl-CoA
Glutamate
2-Oxoglutarate
Acryloyl-CoA
Methylaspartate
Propanoyl-CoA
(R)-Methyl-malonyl-CoA
(S)-Methyl-malonyl-CoA
Succinate semialdehyde
Citramalyl-CoA
3-Methylfumaryl-CoA
Mesaconate
Mesaconyl-CoA
β-Methylmalyl-CoA
(2S)-Methyl-succinyl-CoA
(2R)-Ethyl-malonyl-CoA
(2S)-Ethyl-malonyl-CoA
Acetoacetyl-CoA
(R)-3-Hydroxy-butanoyl-CoA
(S)-3-Hydroxybutanoyl-CoA
Crotonoyl-CoA
Butanoyl-CoA
4-Hydroxybutanoyl-CoA
4-Hydroxybutanoate

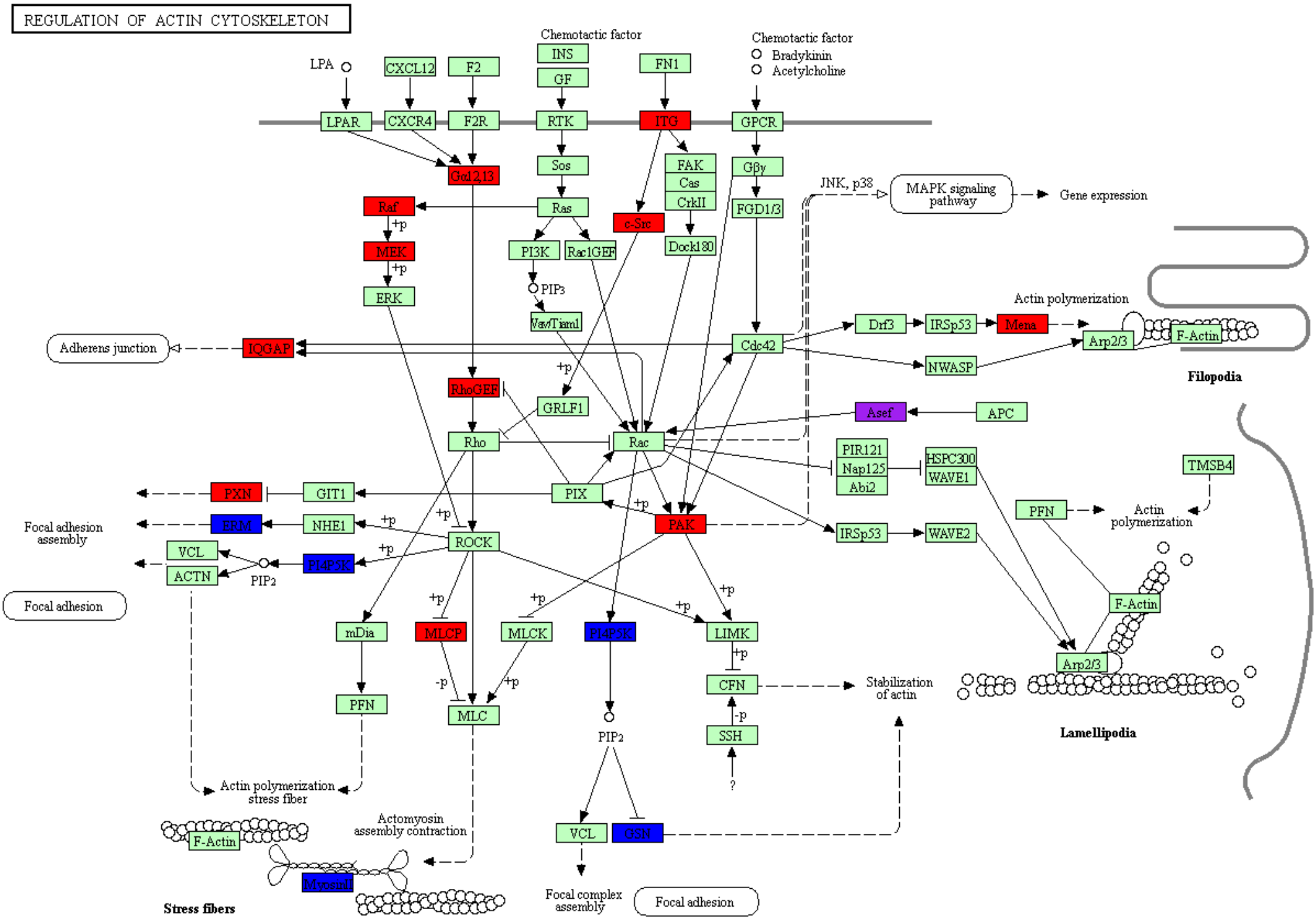

PLATELET ACTIVATION
Platelet
Orai1
Ca2+
TXA2
TP
G13
Rho-GEF
RhoA
ROCK
+p
MPase
-p
MLC
Shape change
+p
Thrombin
PAR1/4
MLCK
IP3
Calcium signaling pathway
ATP
Ca2+
P2X1
STIM1
ER
IP3R
Ca2+
P2Y1
Gq
PLCβ
PKC
Rap1 signaling pathway
Kindlin-3
Complement and coagulation cascade
ADP
RASGRP
Rap1
RIAM
Talin
αIIbβ3
FG
DAG
P2Y12
Gi
AC
cAMP
PKA
+p
VASP
Actin
G13
Aggregation
PIP3
Platelet spreading
RhoA
p190
+p
cSrc
PGI2
IP
Gs
PI3K
Syk
FcγRIIa
Lyn
GP VI
FcRγ
Fyn
+p
Collagen
Syk
SLP76
α2β1
PI3K
PLCγ2
Btk
GPV
GPIbα
GPIbβ
GPIX
Akt
+p
eNOS
NO
sGC
cGMP
PKG
p38
ERK
VWF
PI3K-Akt signaling pathway
Lyn
ECM-receptor interaction
PLA
AA
PTGS1
PGH2
PGG2
TBXAS1
Arachidonic acid metabolism
TXA2
SNAP23
VAMP8
VAMP8
Degranulation

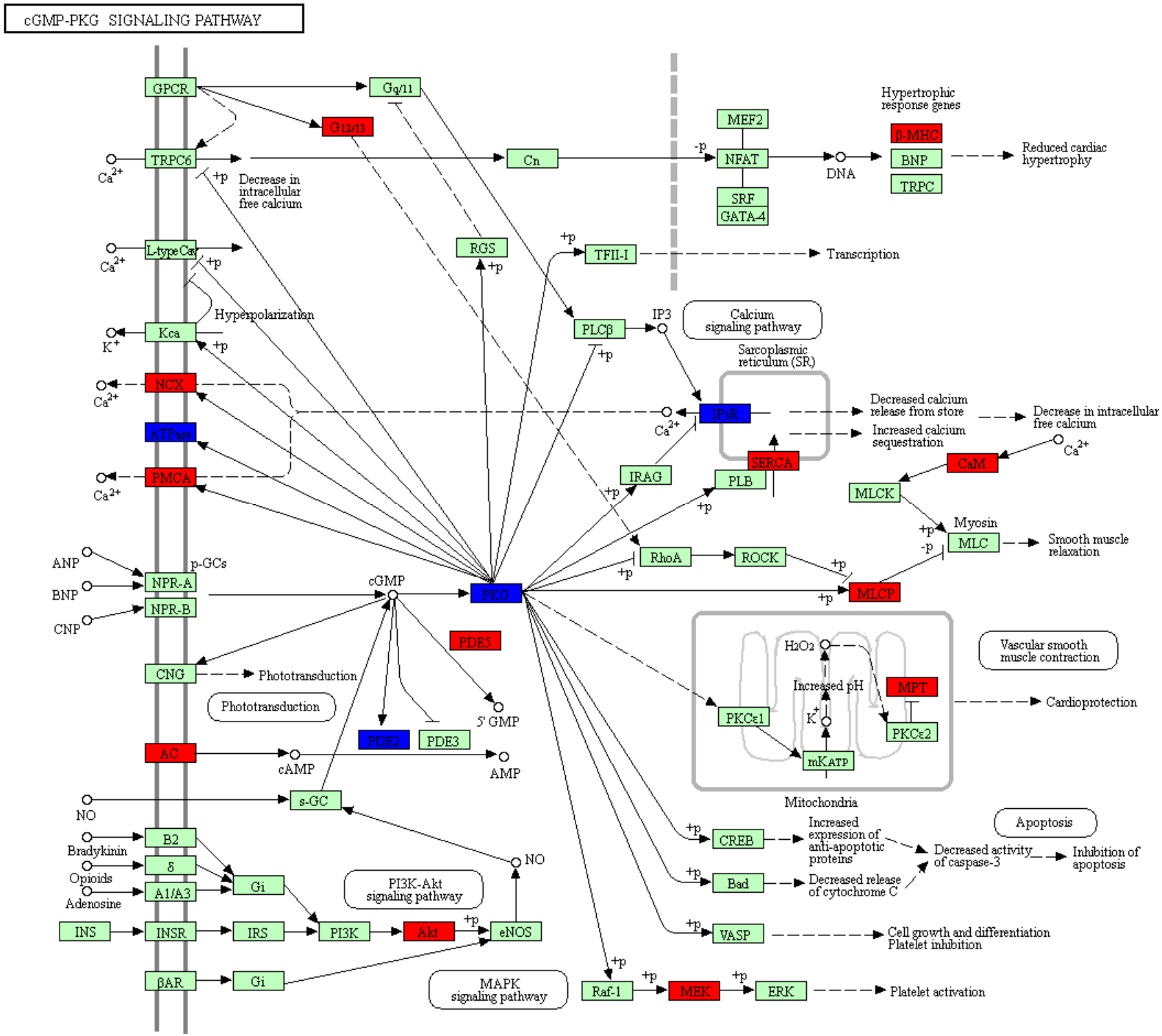

DOPAMINERGIC SYNAPSE
Glial cell
COMT
DOPAC
MAO
HVA
MAO
3-MT
COMT
DA
DAT
DA autoreceptor
D2
Neuron (Presynaptic terminal)
L-tyrosine
TH
Tyrosine metabolism
L-Dopa
DDC
DA
VMAT
Synaptic vesicle cycle
Exocytosis
Endocytosis
VGCC
Ca2+
Parkinson's disease
Action potential
3-MT
MAO
HVA
COMT
DA
DAT
DA
D2
Synaptic cleft
Neuron (Postsynaptic cell)
Calcium signaling pathway
D1
D5
D2
D3, 4
Calcyon
Gq
Gs/olf
Gi/o
PLC
AC5
IP3R
IP3
Ca2+
DAG
cAMP
PKA
CaM
CaMKII
PP2B
PKC
CREB
MAPK
c-fos
PP-1
DARPP32
Synaptic plasticity
Downstream gene regulation
Gβγ
+p
-p
Na+
VSSC
Cav1.2/1.3
Cav2.1/2.2
GIRK
K+
(Increased / decreased) Neuronal excitability
βArrII
PP2A
Akt
GSK-3
NMDAr
AMPAr
Kinesin
Clock
BMAL1
Glutamatergic synapse
Synaptic plasticity


HUMAN CYTOMEGALOVIRUS INFECTION
hCMV
gB
gH/gL
IE1-72
IE2-86
PDGFRA
EGFR
ITGA
ITGB
PI3K Class IA
PIP3
AKT
PI3K-Akt signaling pathway
UL38
TSC1
TSC2
Rheb
mTOR
mTOR signaling pathway
4EBPs
S6K1/2
IKK
NF-κB
NFκB signaling pathway
Priming cell for viral replication
Oncomodulation
Survival
Proliferation
Metastasis
Angiogenesis
Grb2
SOS
Ras
Raf-1
MEK
ERK
MAPK signaling pathway
Elk-1
SP-1
Regulation of actin cytoskeleton
Src
Rac
RhoA
Stress fiber disruption
Cytosolic DNA-signaling pathway
Viral dsDNA
cGAS
cGAMP
STING
TBK1
IRF3
DNA
IFN-α
IFN-β
UL82
TNFα
TNFR1
RIP1
TRADD
TRAF5
TRAF2
TNF signaling pathway
UL26
Inhibition of proinflammatory and innate immue signaling
IE2-86
IκBα
NF-κB
HCMV MIEP
IL1β
IL1R
Proinflammatory cytokines/chemokines
CCL2
CCL5
IL-8
IL-6
No ligand binding
US28
Gβγ
Gαq/11
Gαi/o
Gα12/13
PLCβ
IP3
DAG
ER
Ca2+
CaM
Cn
NFAT
COX-2
Cell survival
Cell proliferation
Angiogenesis
Inflammation
Transformation
CCL3
CCL4
CX3CL1
Rho-GEF
Rho
ROCK
β-catenin
Proliferation
Arachidonic acid metabolism
PGE2
EP1-4
Gαs
AC
PKA
GSK3β
Cyclin D1
c-myc
Jak/STAT signaling pathway
IL-6R
Jak1
STAT3
COX
VEGF
Cell cycle progression
Cell proliferation
Oncogenesis
UL33
MKK6
p38
CREB
CRE-mediated transcription
US27
Neutrophil
CXCL12
CXCR4
PKC
PYK2
FAK
p130CAS
Crk
Paxillin
Migration
CXCR2
cmvIL-10
IL-10R
Anti-inflammatory Immunosupression
vCXCL1
Viral dissemination through preferential attraction of neutrophils
Expression
Processing
Secretion
Interference with MHC1 antigen presentation
US6
Peptides
TAP
Tapasin
Antigenic Peptides
Viral protein
Proteasome
US3
US10
ERp57
CRT
UL22A
MHCI
β2M
US2
US11
Proteasomal degradation of MHC class I
CCR1/β5
CCL5
Inhibition of leukocyte chemotaxis
Antigen processing and presentation
Leukocyte
TNF
TNFRI
TRADD
FADD
Casp8
FasL
Fas
UL36
Apoptosis
UL37x1
Mitochondrion
Brockage of apoptotic pathway
BID
Bax
Bak
CytC
CASP9
CASP3
MDM2
p14ARF
p53
DNA
p21
IE1-72
IE2-86
pp71
CyclinD1
CDK4/6
Rb
E2F
Cell cycle
p16INK4
G1/S progression

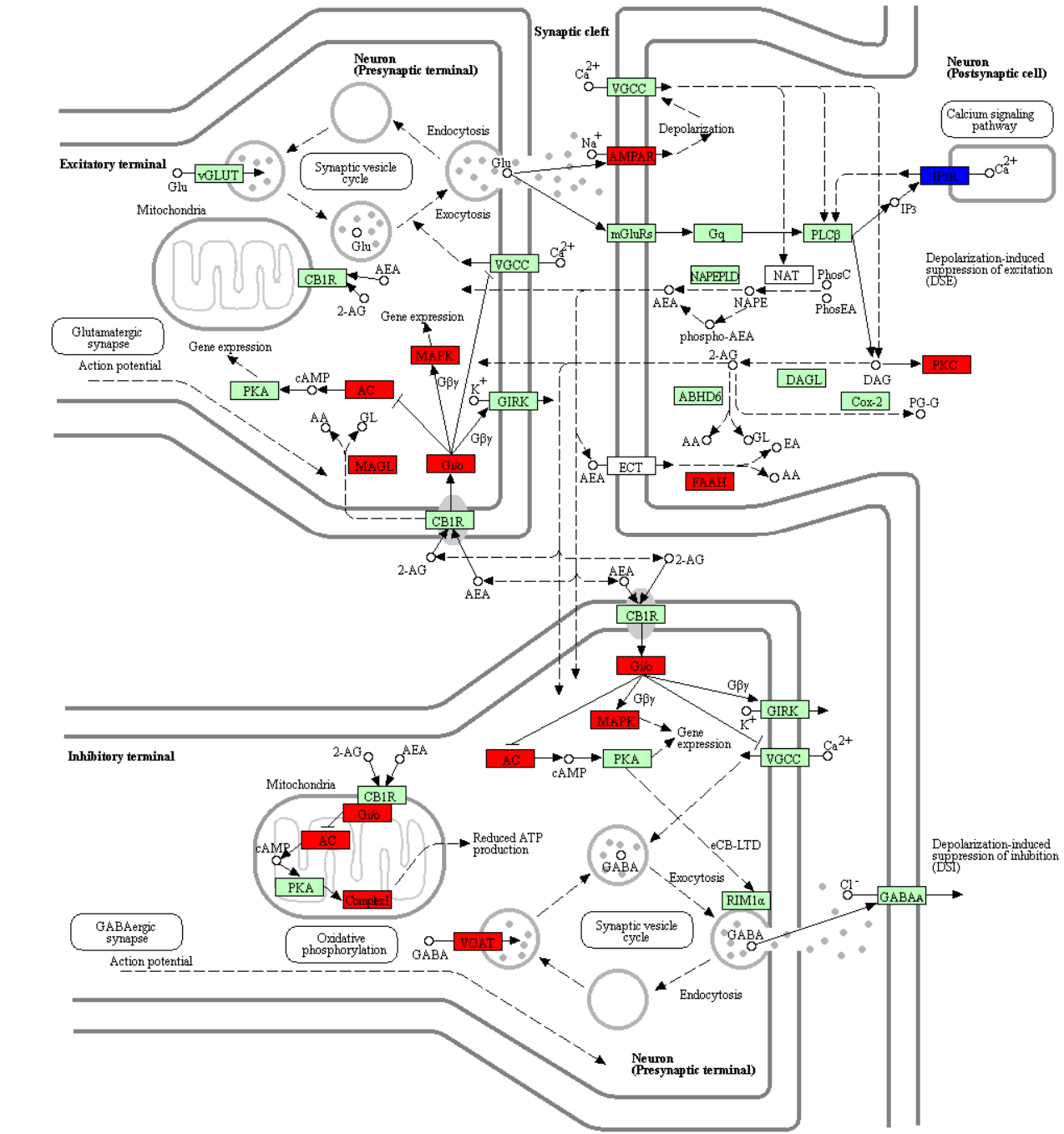
PROTEOGLYCANS IN CANCER



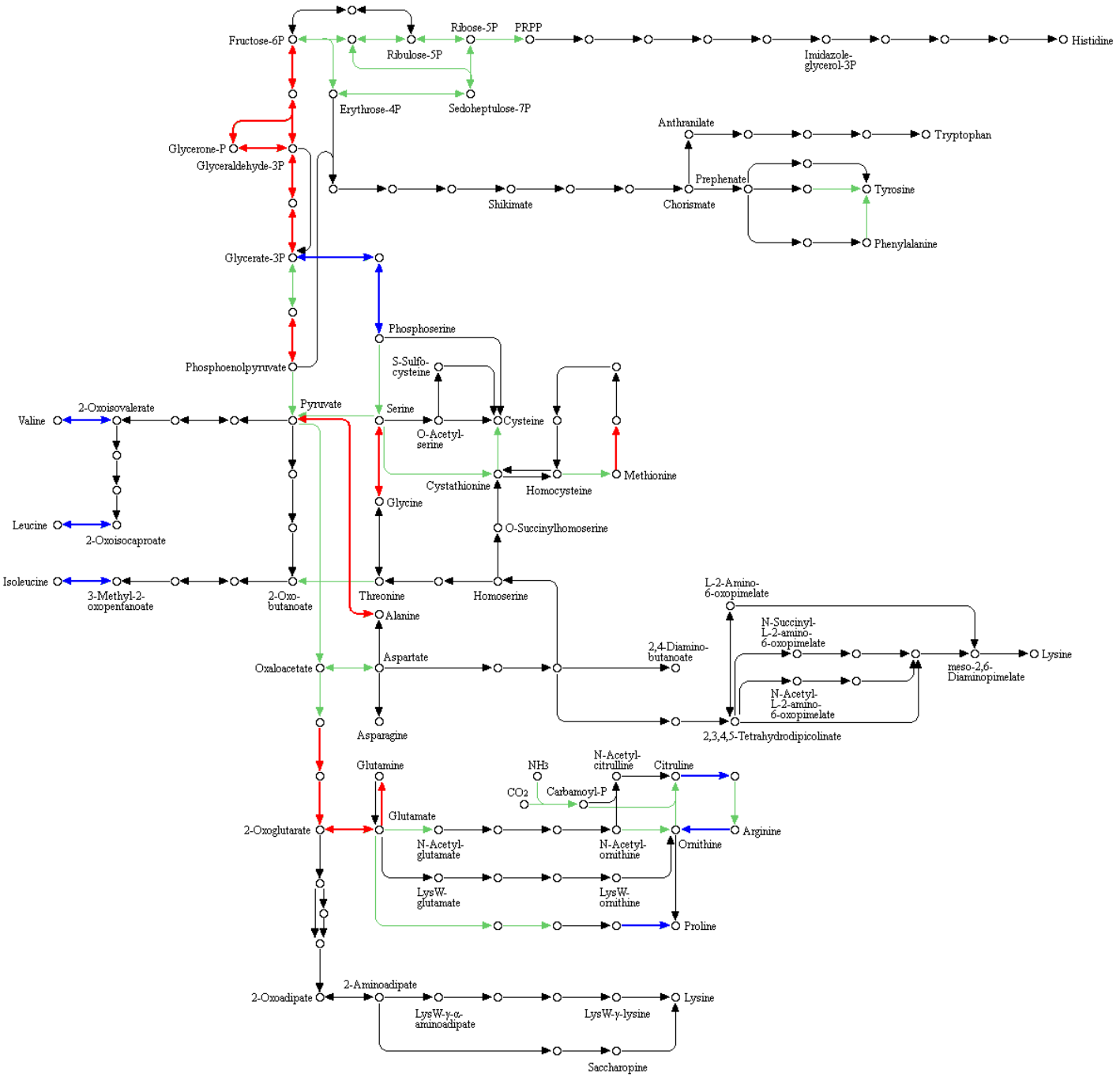

REGULATION OF ACTIN CYTOSKELETON
Chemotactic factor
Chemotactic factor
Bradykinin
Acetylcholine
LPA
CXCL12
F2
INS
GF
FN1
LPAR
CXCR4
F2R
RTK
ITG
GPCR
Gαi2,i3
Sos
FAK
Cas
CrkII
Gβγ
JNK, p38
MAPK signaling pathway
Gene expression
Raf
+p
MEK
+p
ERK
Ras
c-Src
FGD1/3
PI3K
Rac1GEF
Dock180
PIP3
Vav/Tiam1
Actin polymerization
Drf3
IRSp53
Mena
Arp2/3
F-Actin
Filopodia
Adherens junction
IQGAP
Cdc42
NWASP
RhoGEF
+p
GRLF1
Asef
APC
Rho
Rac
PIR121
Nap125
Abi2
HSPC300
WAVE1
TMSB4
PXN
GIT1
PIX
+p
PAK
PFN
Actin polymerization
Focal adhesion assembly
ERM
NHE1
+p
+p
ROCK
IRSp53
WAVE2
VCL
ACTN
PIP2
PI4P5K
+p
F-Actin
Focal adhesion
+p
+p
+p
+p
mDia
MLCP
MLCK
PI4P5K
LIMK
+p
Arp2/3
CFN
Stabilization of actin
-p
+p
PFN
MLC
PIP2
SSH
-p
?
Lamellipodia
Actin polymerization stress fiber
Actomyosin assembly contraction
F-Actin
VCL
GSN
MyosinII
Stress fibers
Focal complex assembly
Focal adhesion

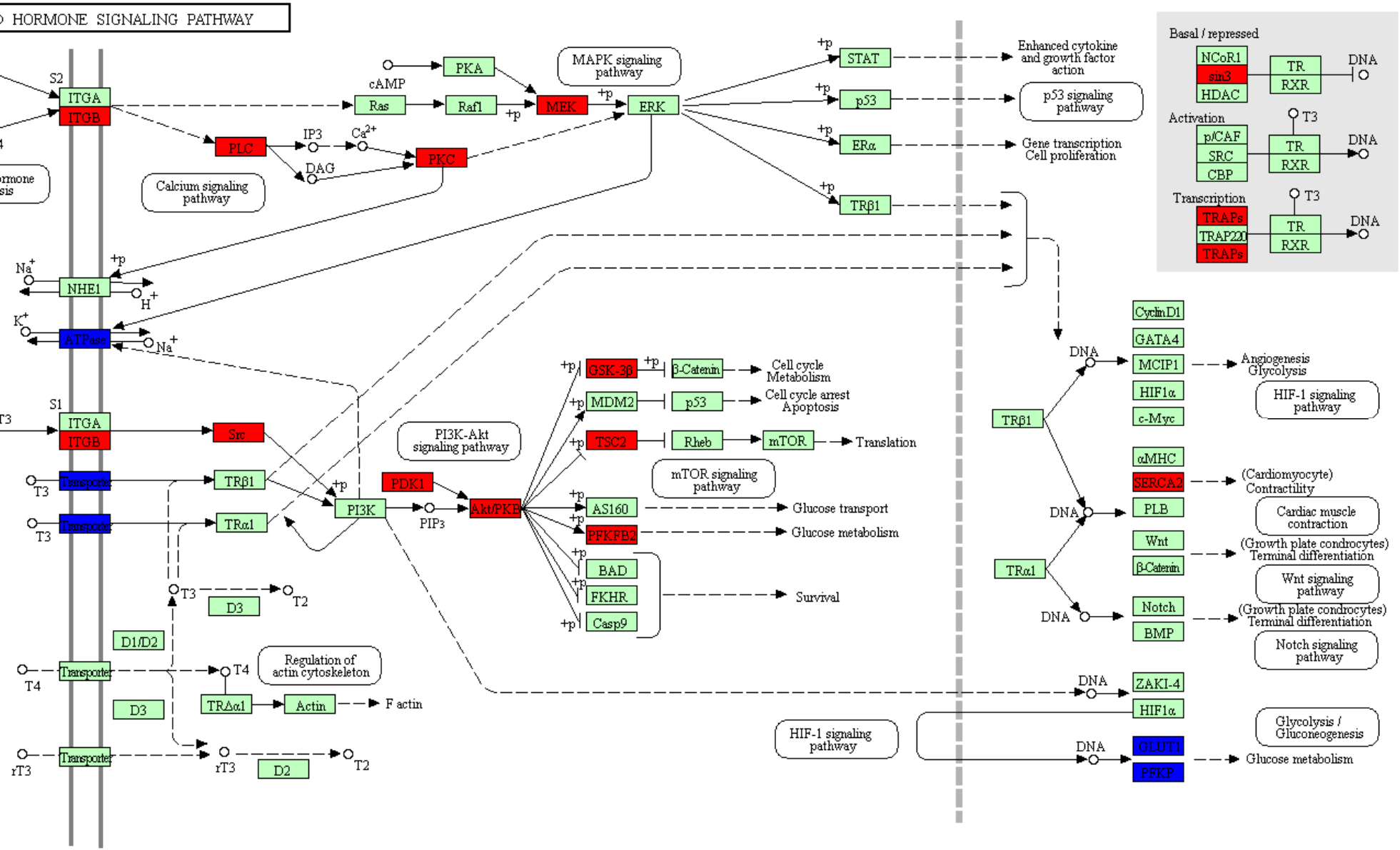

cGMP-PKG SIGNALING PATHWAY
GPCR
Gq/11
G12/13
TRPC6
Ca2+
+p
Decrease in intracellular free calcium
Cn
MEF2
-p
NFAT
SRF
GATA-4
DNA
Hypertrophic response genes
β-MHC
BNP
TRPC
Reduced cardiac hypertrophy
L-type Car
RGS
TFII-I
Transcription
Hyperpolarization
Kca
K+
PLCβ
IP3
Calcium signaling pathway
Sarcoplasmic reticulum (SR)
NCX
IP3R
Decreased calcium release from store
Increased calcium sequestration
Decrease in intracellular free calcium
ATPase
SERCA
CaM
PMCA
IRAG
PLB
MLCK
Myosin
MLC
Smooth muscle relaxation
ANP
BNP
CNP
p-GCs
NPR-A
NPR-B
cGMP
PKG
RhoA
ROCK
MLCP
PDE5
CNG
Phototransduction
5' GMP
PDE2
PDE3
AC
cAMP
AMP
H2O2
Increased pH
MPT
PKCε1
PKCε2
mKATP
Mitochondria
Vascular smooth muscle contraction
Cardioprotection
NO
s-GC
B2
Bradykinin
δ
Opioids
A1/A3
Adenosine
Gi
PI3K-Akt signaling pathway
INS
INSR
IRS
PI3K
Akt
eNOS
βAR
CREB
Increased expression of anti-apoptotic proteins
Apoptosis
Decreased activity of caspase-3
Inhibition of apoptosis
Bad
Decreased release of cytochrome C
VASP
Cell growth and differentiation
Platelet inhibition
MAPK signaling pathway
Raf-1
MEK
ERK
Platelet activation

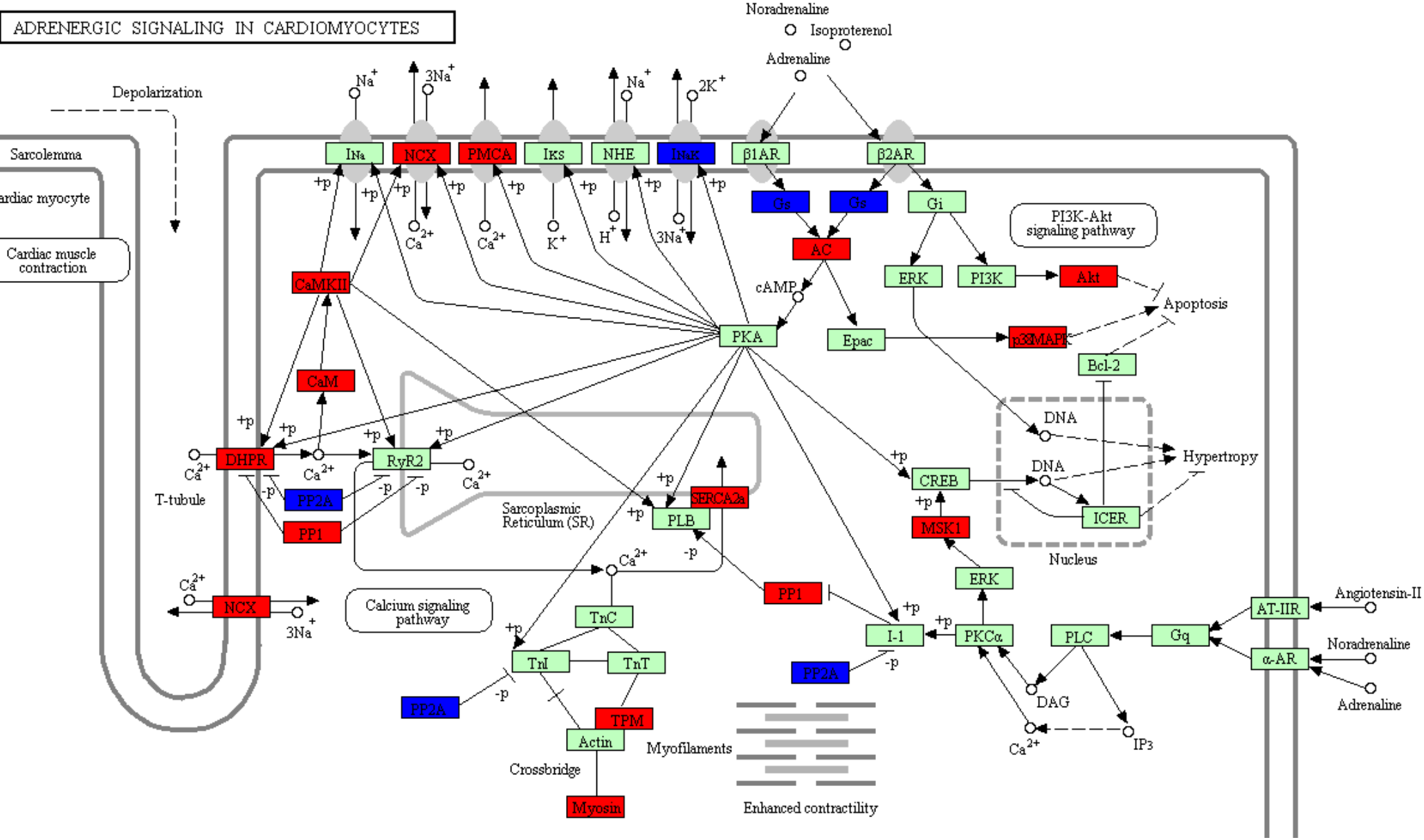
RETROGRADE ENDOCANNABINOID SIGNALING

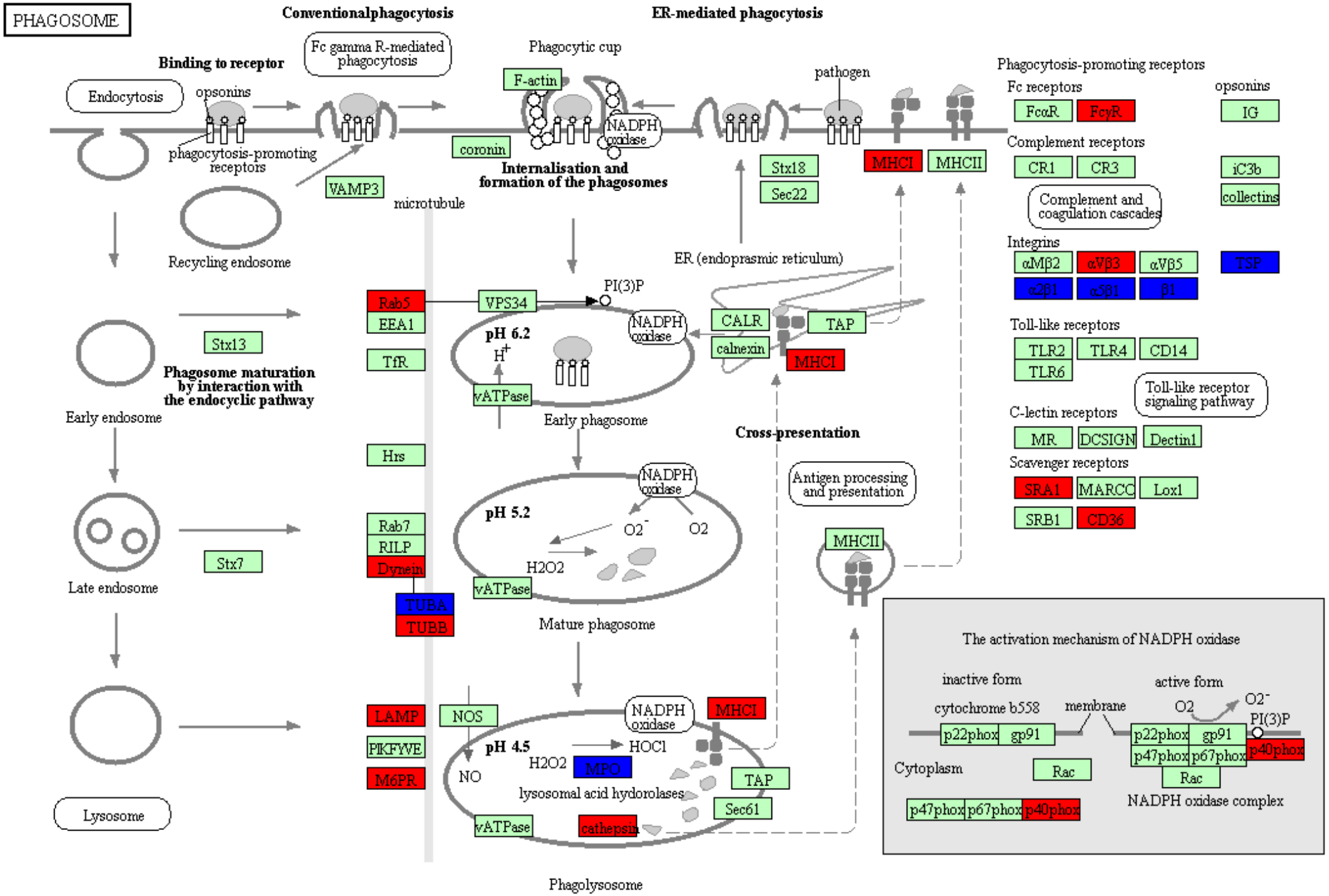


BIOSYNTHESIS OF AMINO ACIDS

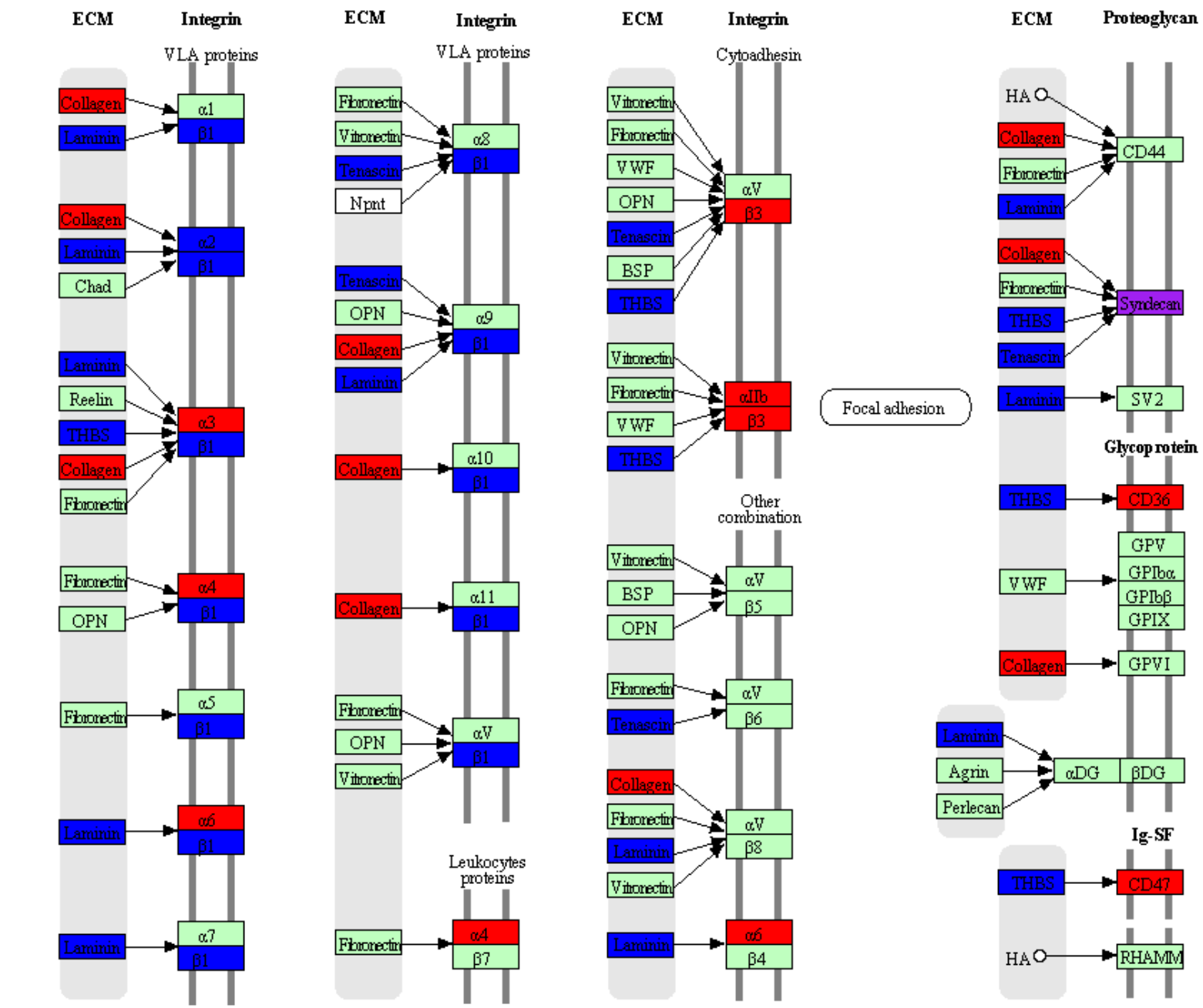


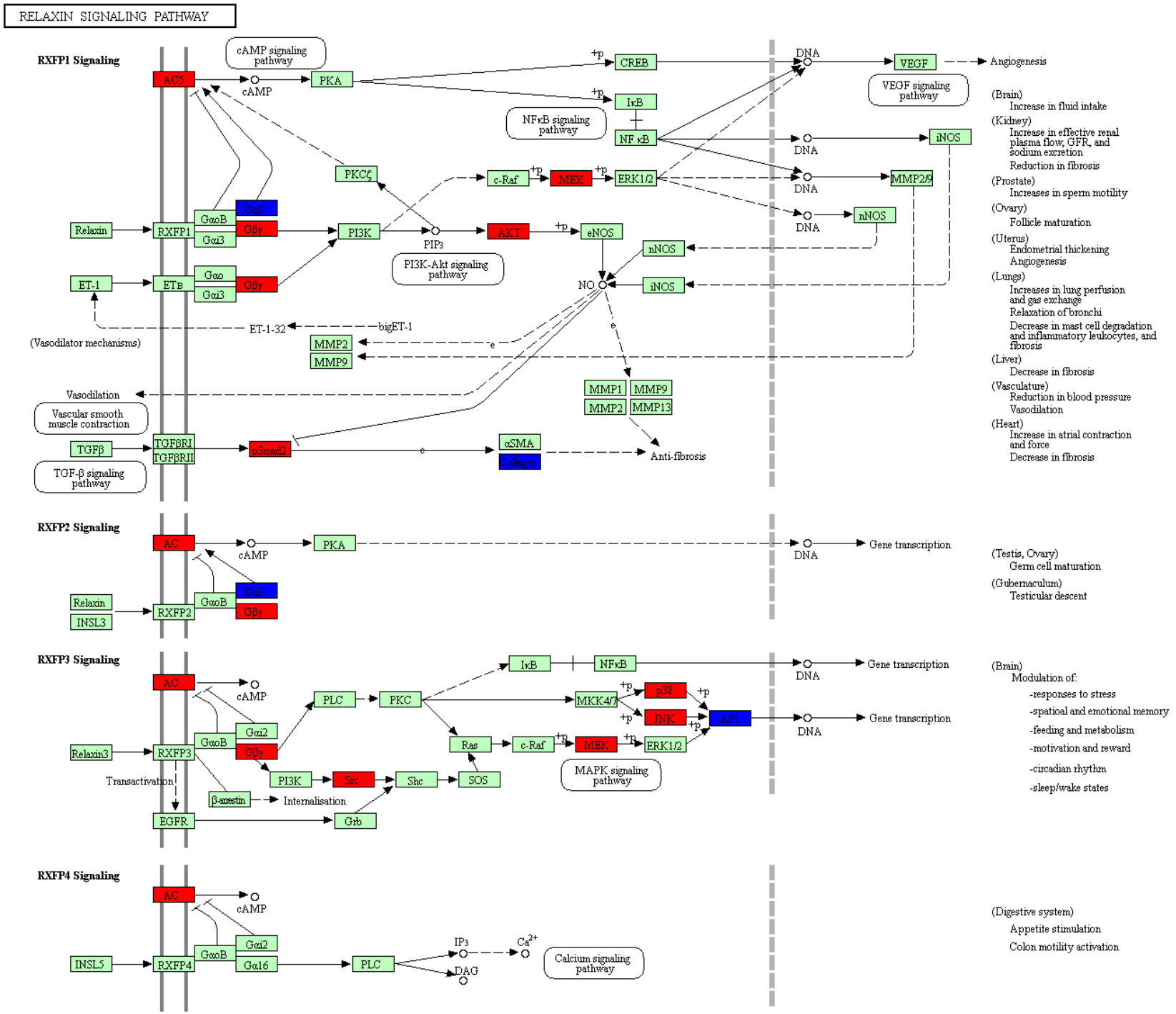

HORMONE SIGNALING PATHWAY
S2
ITGA
ITGB
S1
ITGA
ITGB
Transporter
Transporter
Transporter
Transporter
NHE1
ATPase
PLC
IP3
Ca2+
DAG
PKC
Calcium signaling pathway
cAMP
PKA
Ras
Raf1
MEK
ERK
MAPK signaling pathway
Src
TRβ1
TRα1
PI3K
PIP3
PDK1
Akt/PKB
PI3K-Akt signaling pathway
GSK-3β
β-Catenin
Cell cycle Metabolism
MDM2
p53
Cell cycle arrest Apoptosis
TSC2
Rheb
mTOR
Translation
mTOR signaling pathway
AS160
Glucose transport
PFKFB2
Glucose metabolism
BAD
FKHR
Casp9
Survival
STAT
Enhanced cytokine and growth factor action
p53
p53 signaling pathway
ERα
Gene transcription Cell proliferation
TRβ1
Basal / repressed
NCoR1
sin3
HDAC
TR
RXR
DNA
Activation
T3
p/CAF
SRC
CBP
TR
RXR
DNA
Transcription
T3
TRAPs
TRAP220
TRAPs
TR
RXR
DNA
TRβ1
TRα1
DNA
CyclinD1
GATA4
MCIP1
HIF1α
c-Myc
Angiogenesis Glycolysis
HIF-1 signaling pathway
αMHC
SERCA2
PLB
(Cardiomyocyte) Contractility
Cardiac muscle contraction
Wnt
β-Catenin
(Growth plate condrocytes) Terminal differentiation
Wnt signaling pathway
Notch
BMP
(Growth plate condrocytes) Terminal differentiation
Notch signaling pathway
T3
D3
T2
D1/D2
T4
T4
Regulation of actin cytoskeleton
TRΔα1
Actin
F actin
D3
rT3
rT3
D2
T2
HIF-1 signaling pathway
DNA
ZAKI-4
HIF1α
DNA
GLUT1
PFKP
Glycolysis / Gluconeogenesis
Glucose metabolism

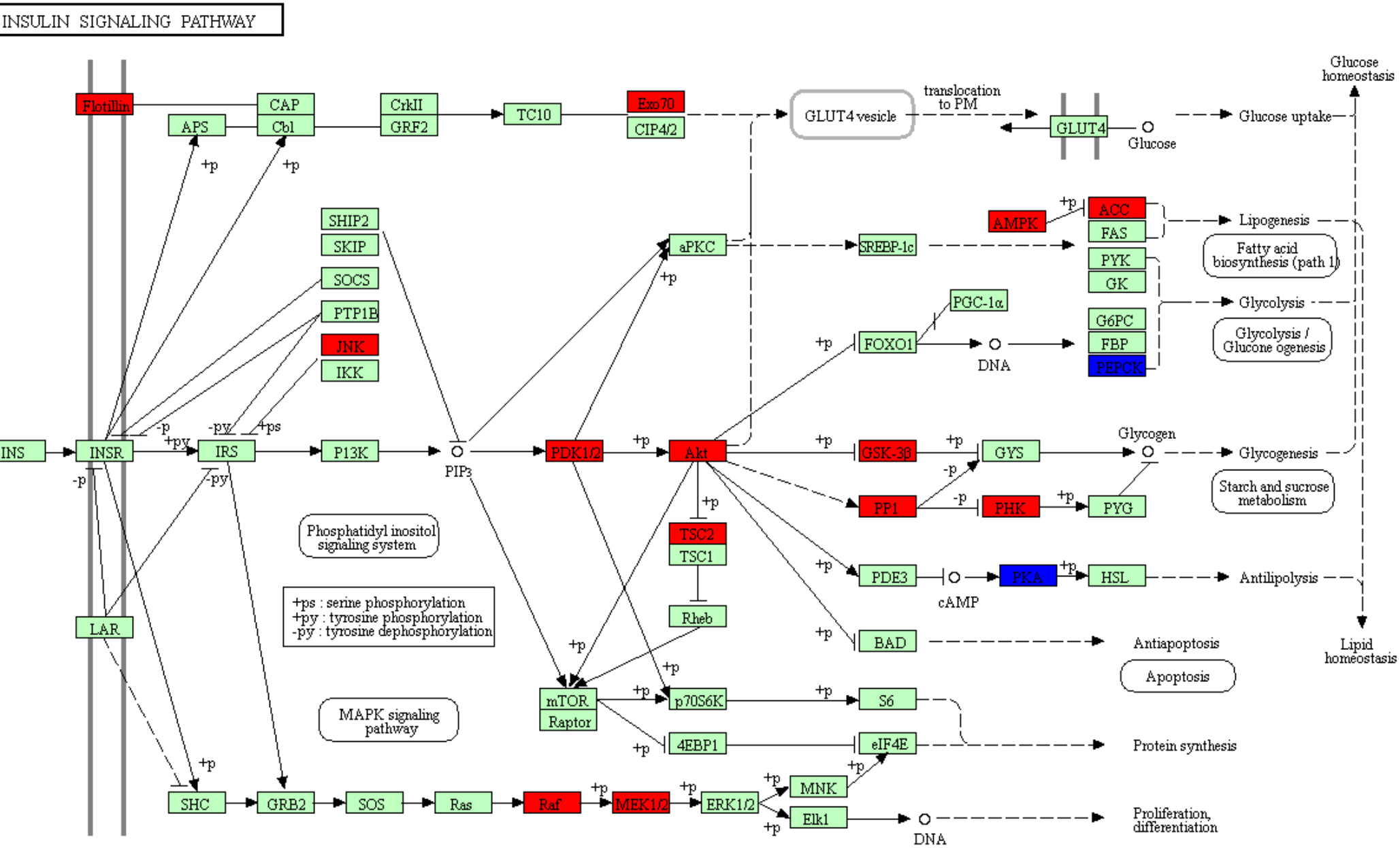

ADRENERGIC SIGNALING IN CARDIOMYOCYTES
Noradrenaline
Isoproterenol
Adrenaline
Depolarization
Sarcolemma
ardiac myocyte
Cardiac muscle contraction
INa
NCX
PMCA
IKs
NHE
INaK
β1AR
β2AR
Gs
Gs
Gi
AC
cAMP
PKA
CaMKII
CaM
DHPR
RyR2
T-tubule
PP2A
PP1
Sarcoplasmic Reticulum (SR)
SERCA2a
PLB
PI3K-Akt signaling pathway
ERK
PI3K
Akt
Apoptosis
Epac
p38MAPK
Bcl-2
DNA
Hypertropy
CREB
MSK1
ICER
Nucleus
Calcium signaling pathway
TnC
TnI
TnT
TPM
Actin
Crossbridge
Myosin
Myofilaments
Enhanced contractility
I-1
PKCα
PLC
Gq
AT-IIR
α-AR
Angiotensin-II
Noradrenaline
Adrenaline
DAG
IP3

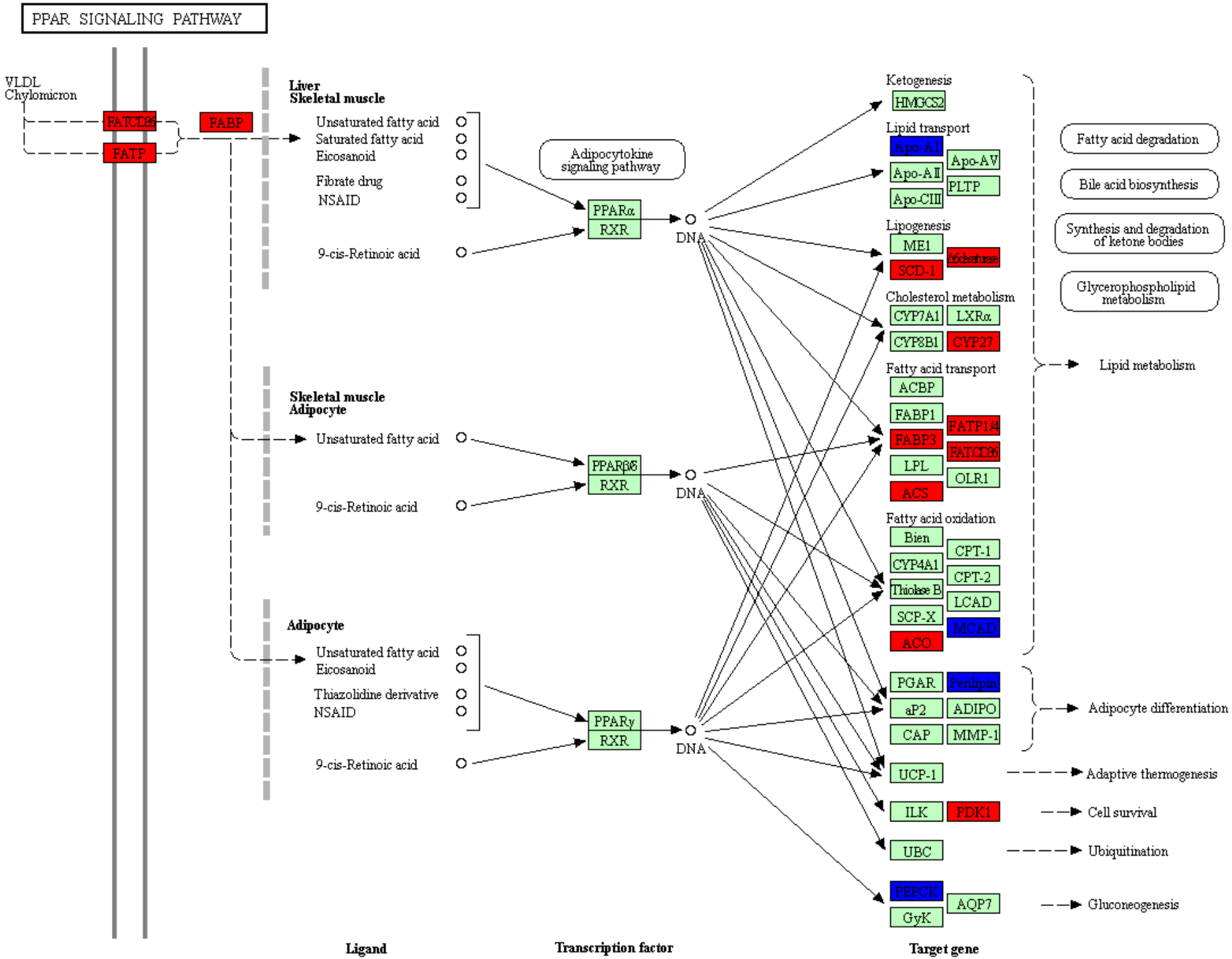

PHAGOSOME
Conventionalphagocytosis
ER-mediated phagocytosis
Binding to receptor
Fc gamma R-mediated phagocytosis
Phagocytic cup
pathogen
Endocytosis
opsonins
F-actin
NADPH oxidase
coronin
phagocytosis-promoting receptors
Internalisation and formation of the phagosomes
Stx18
Sec22
MHCI
MHCII
VAMP3
microtubule
Recycling endosome
ER (endoprasmic reticulum)
Phagocytosis-promoting receptors
Fc receptors
FcαR
FcγR
opsonins
IG
Complement receptors
CR1
CR3
iC3b
collectins
Complement and coagulation cascades
Integrins
αMβ2
αVβ3
αVβ5
TSP
α2β1
α5β1
β1
Toll-like receptors
TLR2
TLR4
CD14
TLR6
Toll-like receptor signaling pathway
C-lectin receptors
MR
DCSIGN
Dectin1
Scavenger receptors
SRA1
MARCO
Lox1
SRB1
CD36
Rab5
EEA1
VPS34
PI(3)P
NADPH oxidase
CALR
TAP
calnexin
MHCI
pH 6.2
H+
vATPase
Early phagosome
Stx13
Phagosome maturation by interaction with the endocyclic pathway
TfR
Early endosome
Cross-presentation
Antigen processing and presentation
Hrs
NADPH oxidase
pH 5.2
O2-
O2
H2O2
vATPase
MHCII
Rab7
RILP
Dynein
Stx7
Late endosome
TUBA
TUBB
Mature phagosome
LAMP
NOS
NADPH oxidase
MHCI
PIKFYVE
pH 4.5
HOCl
H2O2
MPO
M6PR
NO
TAP
lysosomal acid hydorolases
Sec61
vATPase
cathepsin
Lysosome
Phagolysosome
The activation mechanism of NADPH oxidase
inactive form
active form
cytochrome b558
membrane
O2
O2-
PI(3)P
p22phox
gp91
p22phox
gp91
p47phox
p67phox
p40phox
Cytoplasm
Rac
Rac
p47phox
p67phox
p40phox
NADPH oxidase complex

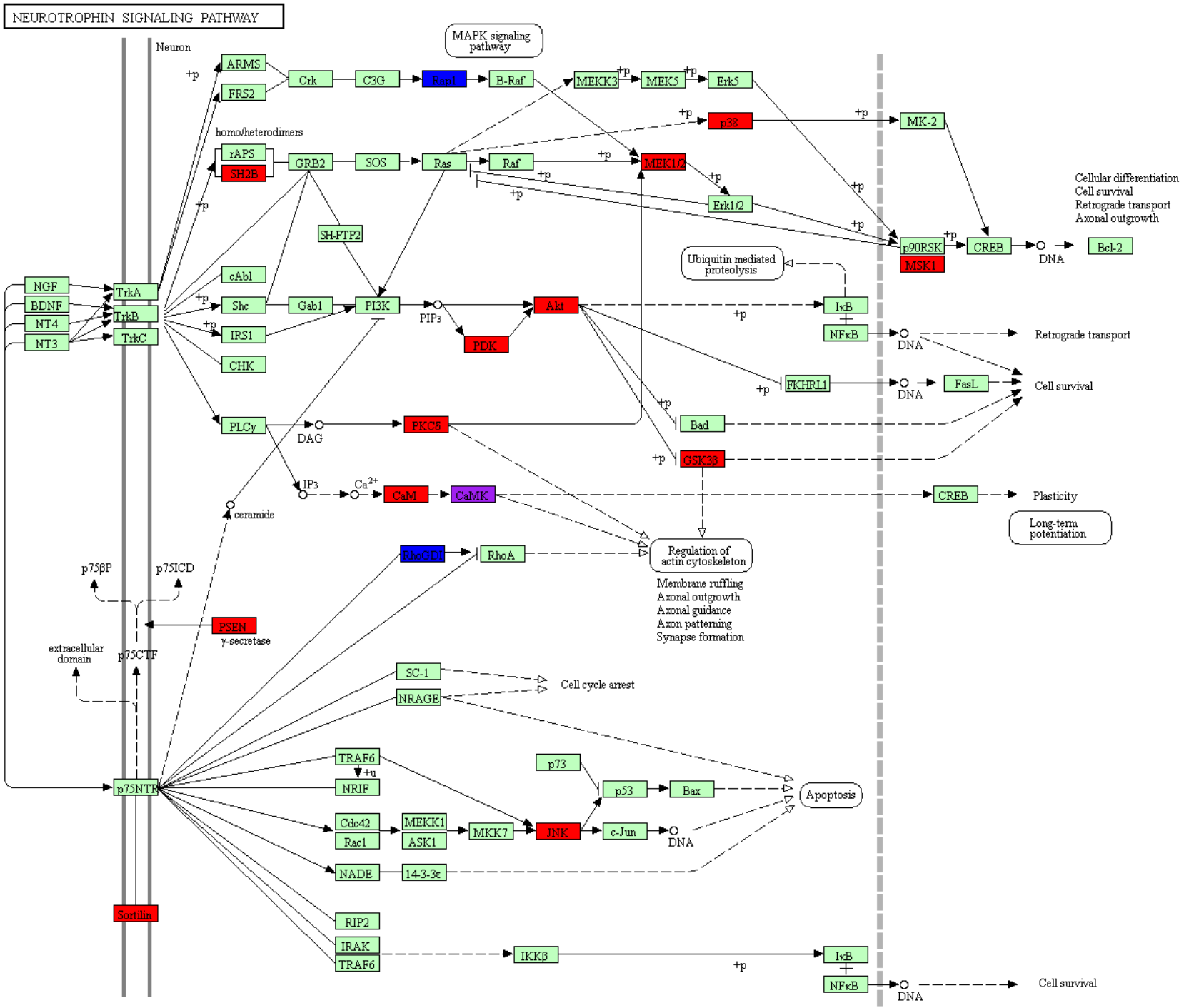
ECM-RECEPTOR INTERACTION

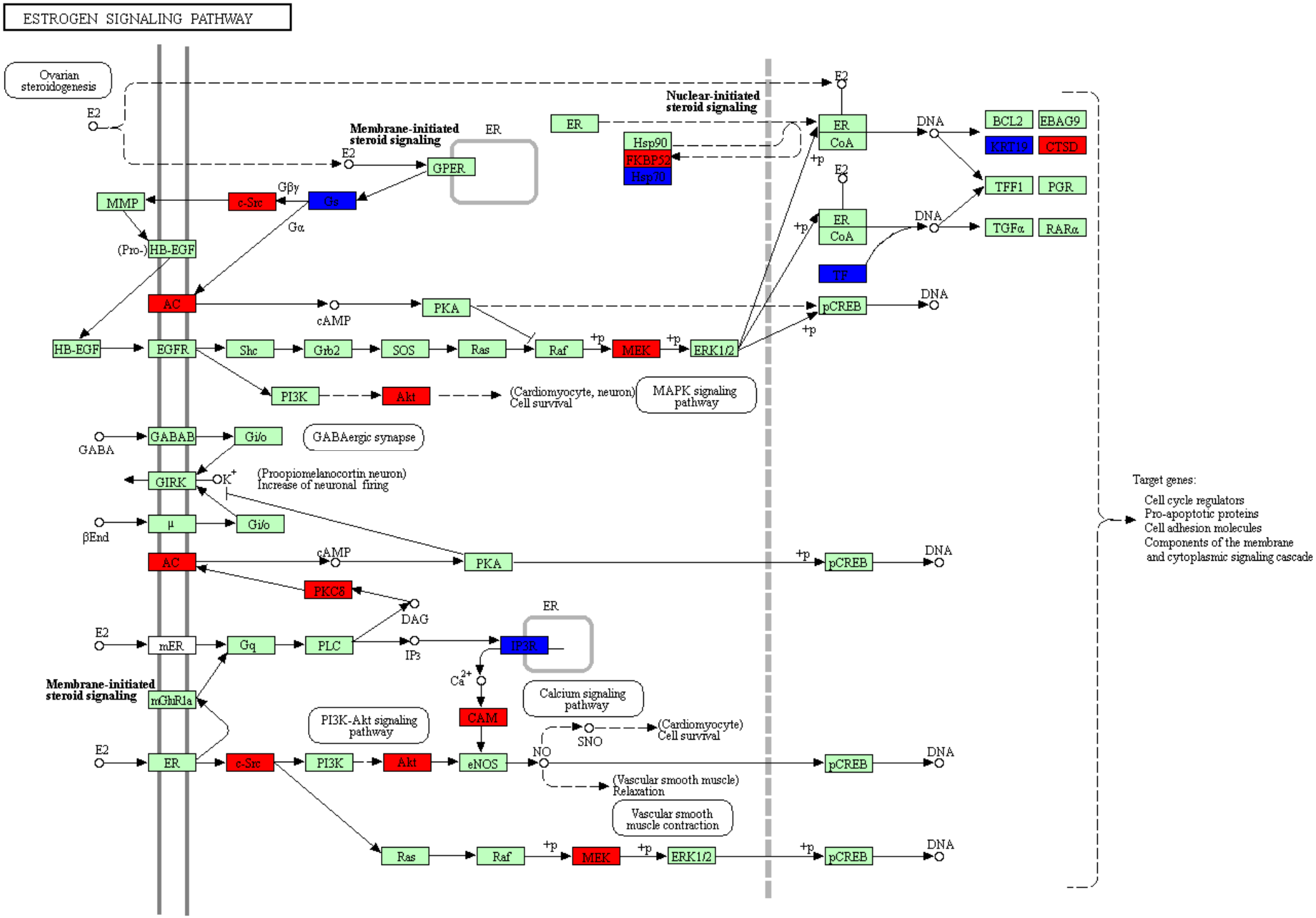


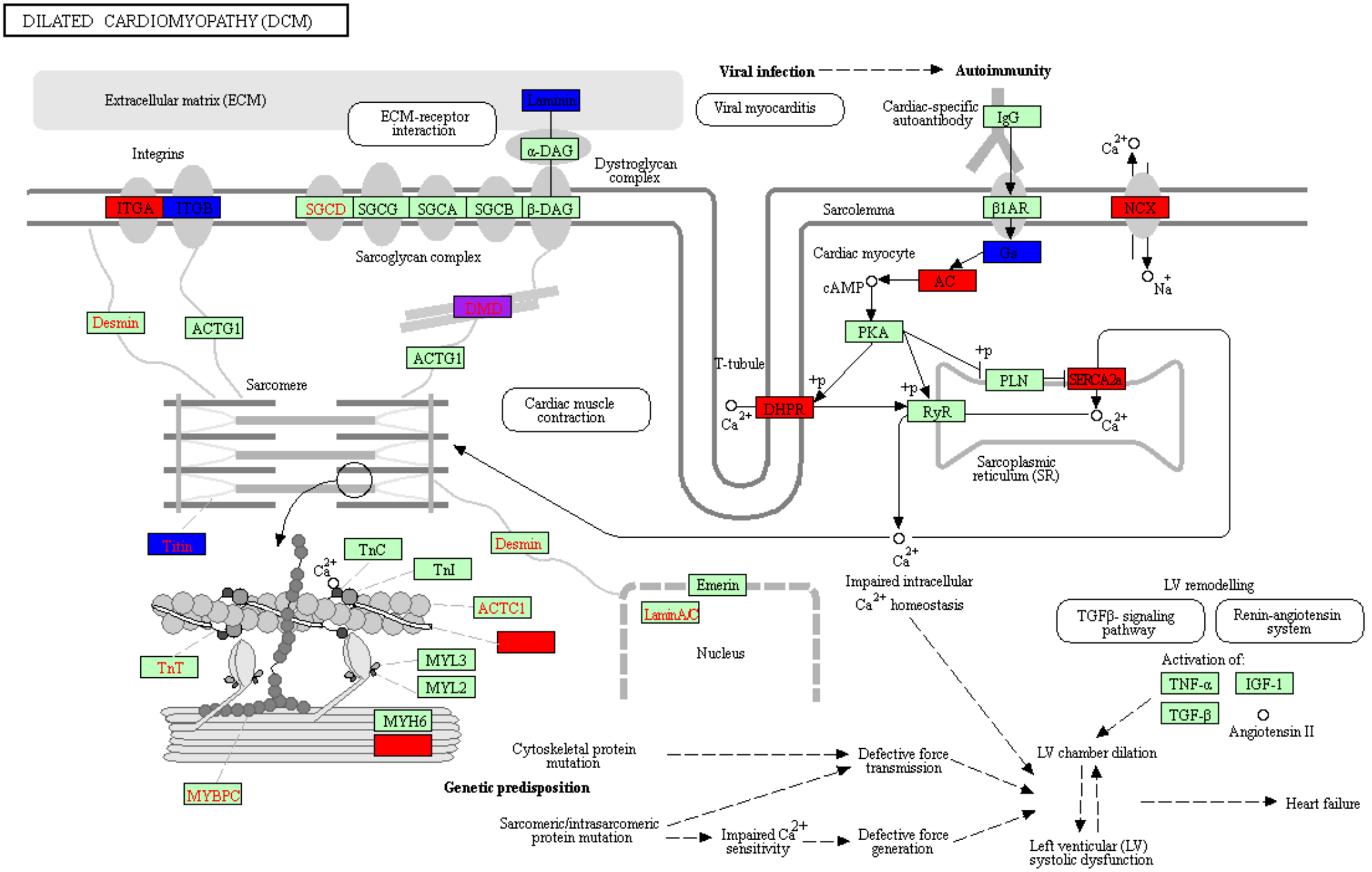

RELAXIN SIGNALING PATHWAY
RXFP1 Signaling
cAMP signaling pathway
AC5
cAMP
PKA
CREB
DNA
VEGF
Angiogenesis
VEGF signaling pathway
IκB
NFκB signaling pathway
NF κB
iNOS
PKCζ
c-Raf
MEK
ERK1/2
MMP2/9
Relaxin
RXFP1
Gαs
Gαoβ
Gβγ
Gαi3
PI3K
PIP3
AKT
eNOS
nNOS
PI3K-Akt signaling pathway
NO
ET-1
ETB
Gαo
Gαi3
Gβγ
ET-1-32
bigET-1
(Vasodilator mechanisms)
MMP2
MMP9
MMP1
MMP13
Vasodilation
Vascular smooth muscle contraction
TGFβ
TGFβRI
TGFβRII
pSmad2
αSMA
Collagen
Anti-fibrosis
TGF-β signaling pathway
(Brain)
Increase in fluid intake
(Kidney)
Increase in effective renal plasma flow, GFR, and sodium excretion
Reduction in fibrosis
(Prostate)
Increases in sperm motility
(Ovary)
Follicle maturation
(Uterus)
Endometrial thickening
Angiogenesis
(Lungs)
Increases in lung perfusion and gas exchange
Relaxation of bronchi
Decrease in mast cell degradation and inflammatory leukocytes, and fibrosis
(Liver)
Decrease in fibrosis
(Vasculature)
Reduction in blood pressure
Vasodilation
(Heart)
Increase in atrial contraction and force
Decrease in fibrosis
RXFP2 Signaling
AC
cAMP
PKA
Gene transcription
Relaxin
INSL3
RXFP2
Gαs
Gαoβ
Gβγ
(Testis, Ovary)
Germ cell maturation
(Gubernaculum)
Testicular descent
RXFP3 Signaling
AC
cAMP
PLC
PKC
IκB
NFκB
MKK4/7
p38
JNK
AP1
Ras
c-Raf
MEK
ERK1/2
MAPK signaling pathway
Relaxin3
RXFP3
Gαi2
Gαoβ
Gβγ
PI3K
Src
Shc
SOS
Transactivation
β-arrestin
Internalisation
EGFR
Grb
(Brain)
Modulation of:
-responses to stress
-spatioal and emotional memory
-feeding and metabolism
-motivation and reward
-circadian rhythm
-sleep/wake states
RXFP4 Signaling
AC
cAMP
INSL5
RXFP4
Gαi2
Gαoβ
Gα16
PLC
IP3
Ca2+
DAG
Calcium signaling pathway
(Digestive system)
Appetite stimulation
Colon motility activation


INSULIN SIGNALING PATHWAY
Flotillin
CAP
Cbl
APS
CrkII
GRF2
TC10
Exo70
CIP4/2
GLUT4 vesicle
translocation to PM
GLUT4
Glucose
Glucose uptake
Glucose homeostasis
SHIP2
SKIP
SOCS
PTP1B
JNK
IKK
aPKC
SREBP-1c
AMPK
ACC
FAS
Lipogenesis
Fatty acid biosynthesis (path 1)
PYK
GK
Glycolysis
Glycolysis / Glucone ogenesis
PGC-1α
FOXO1
DNA
G6PC
FBP
PEPCK
INS
INSR
IRS
P13K
PIP3
PDK1/2
Akt
GSK-3β
GYS
Glycogen
Glycogenesis
Starch and sucrose metabolism
PP1
PHK
PYG
TSC2
TSC1
Rheb
PDE3
cAMP
PKA
HSL
Antilipolysis
BAD
Antiapoptosis
Apoptosis
Lipid homeostasis
LAR
Phosphatidyl inositol signaling system
+ps : serine phosphorylation
+py : tyrosine phosphorylation
-py : tyrosine dephosphorylation
mTOR
Raptor
p70S6K
S6
4EBP1
eIF4E
Protein synthesis
MAPK signaling pathway
SHC
GRB2
SOS
Ras
Raf
MEK1/2
ERK1/2
MNK
Elk1
DNA
Proliferation, differentiation

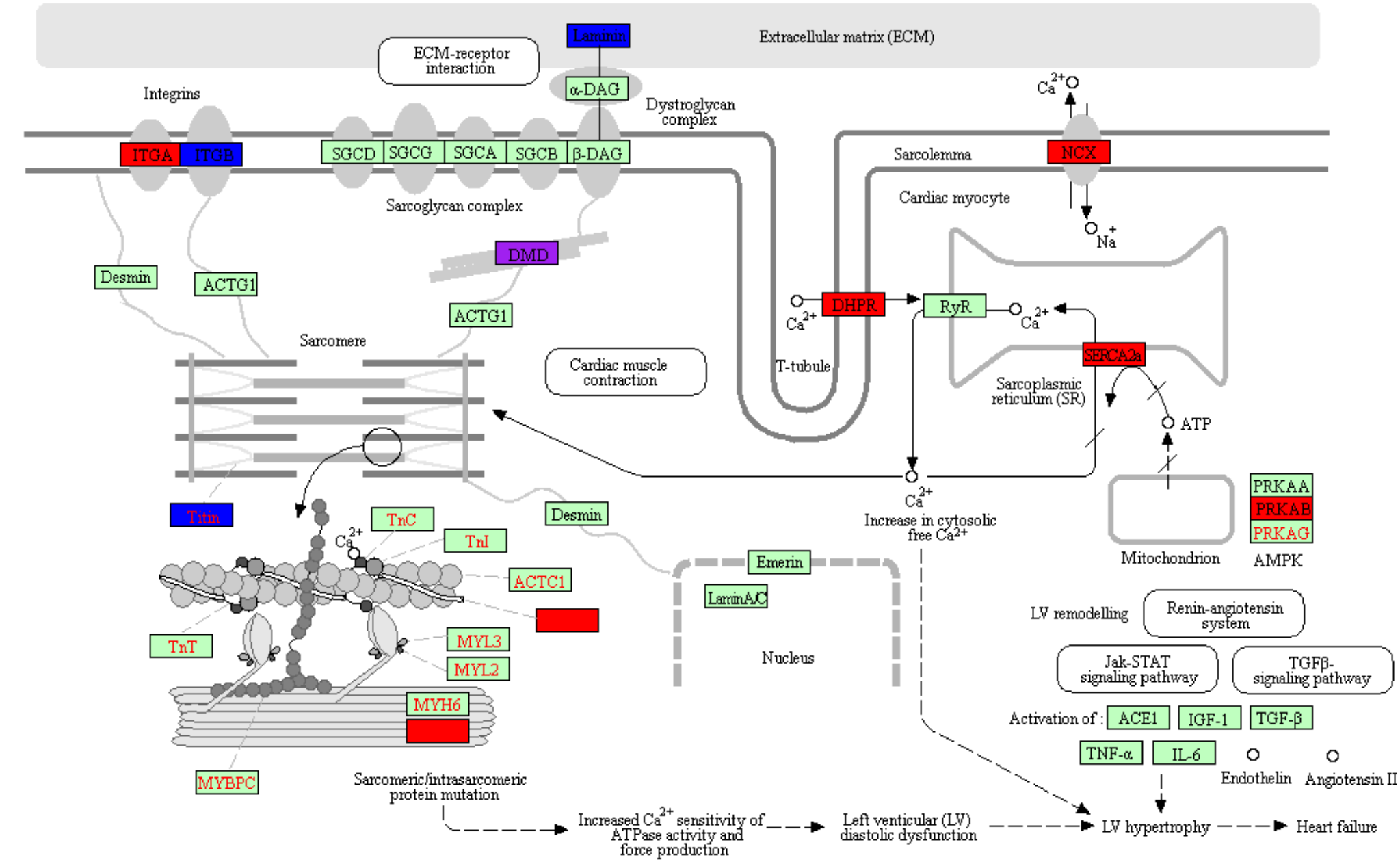

PPAR SIGNALING PATHWAY
VLDL
Chylomicron
FATCD36
FATP
FABP
Liver
Skeletal muscle
Unsaturated fatty acid
Saturated fatty acid
Eicosanoid
Fibrate drug
NSAID
9-cis-Retinoic acid
Adipocytokine signaling pathway
PPARα
RXR
DNA
Skeletal muscle
Adipocyte
Unsaturated fatty acid
9-cis-Retinoic acid
PPARβδ
RXR
DNA
Adipocyte
Unsaturated fatty acid
Eicosanoid
Thiazolidine derivative
NSAID
9-cis-Retinoic acid
PPARγ
RXR
DNA
Ketogenesis
HMGCS2
Lipid transport
Apo-AI
Apo-AV
Apo-AII
PLTP
Apo-CIII
Lipogenesis
ME1
Δ6desturase
SCD-1
Cholesterol metabolism
CYP7A1
LXRα
CYP8B1
CYP27
Fatty acid transport
ACBP
FABP1
FATP1/4
FABP3
FATCD36
LPL
OLR1
ACS
Fatty acid oxidation
Bien
CPT-1
CYP4A1
CPT-2
Thiolase B
LCAD
SCP-X
MCAD
ACO
PGAR
Perilipin
aP2
ADIPO
CAP
MMP-1
UCP-1
ILK
PDK1
UBC
PEPCK
AQP7
GyK
Fatty acid degradation
Bile acid biosynthesis
Synthesis and degradation of ketone bodies
Glycerophospholipid metabolism
Lipid metabolism
Adipocyte differentiation
Adaptive thermogenesis
Cell survival
Ubiquitination
Gluconeogenesis
Ligand
Transcription factor
Target gene

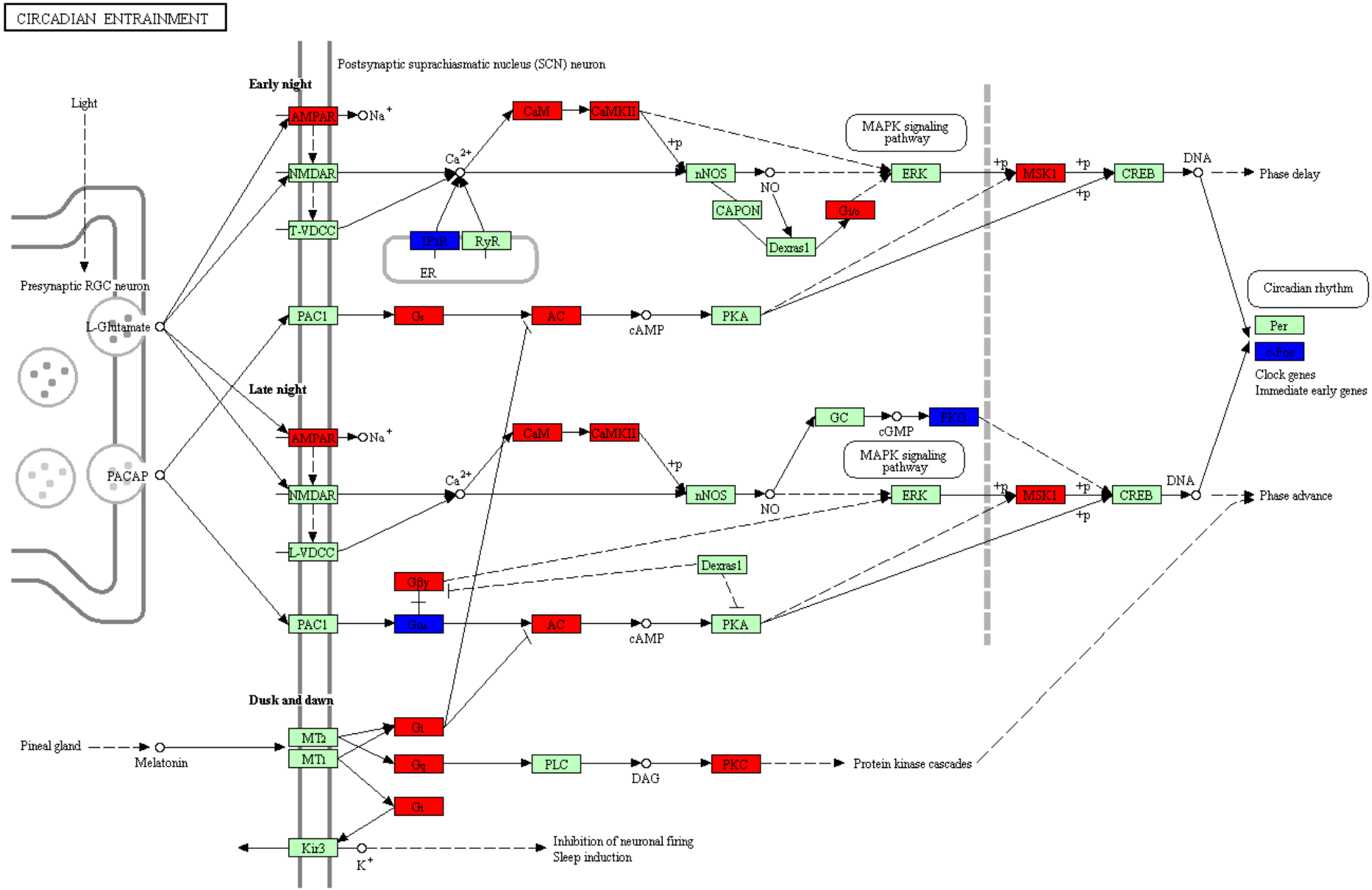

NEUROTROPHIN SIGNALING PATHWAY
Neuron
MAPK signaling pathway
ARMS
FRS2
Crk
C3G
Rap1
B-Raf
MEKK3
MEK5
Erk5
p38
MK-2
homo/heterodimers
rAPS
SH2B
GRB2
SOS
Ras
Raf
MEK1/2
Erk1/2
SH-PTP2
cAbl
Shc
Gab1
PI3K
PIP3
Akt
PDK
IRS1
CHK
PLCγ
DAG
PKCδ
IP3
Ca2+
CaM
CaMK
ceramide
NGF
BDNF
NT4
NT3
TrkA
TrkB
TrkC
Ubiquitin mediated proteolysis
IκB
NFκB
DNA
p90RSK
MSK1
CREB
Bcl-2
Cellular differentiation
Cell survival
Retrograde transport
Axonal outgrowth
Retrograde transport
FKHRL1
FasL
Cell survival
Bad
GSK3β
Plasticity
Long-term potentiation
RhoGDI
RhoA
Regulation of actin cytoskeleton
Membrane ruffling
Axonal outgrowth
Axonal guidance
Axon patterning
Synapse formation
p75βP
p75ICD
PSEN
γ-secretase
extracellular domain
p75CTF
SC-1
NRAGE
Cell cycle arrest
p75NTR
TRAF6
NRIF
p73
p53
Bax
Apoptosis
Cdc42
Rac1
MEKK1
ASK1
MKK7
JNK
c-Jun
NADE
14-3-3ε
Sortilin
RIP2
IRAK
TRAF6
IKKβ
+p
+u
DNA

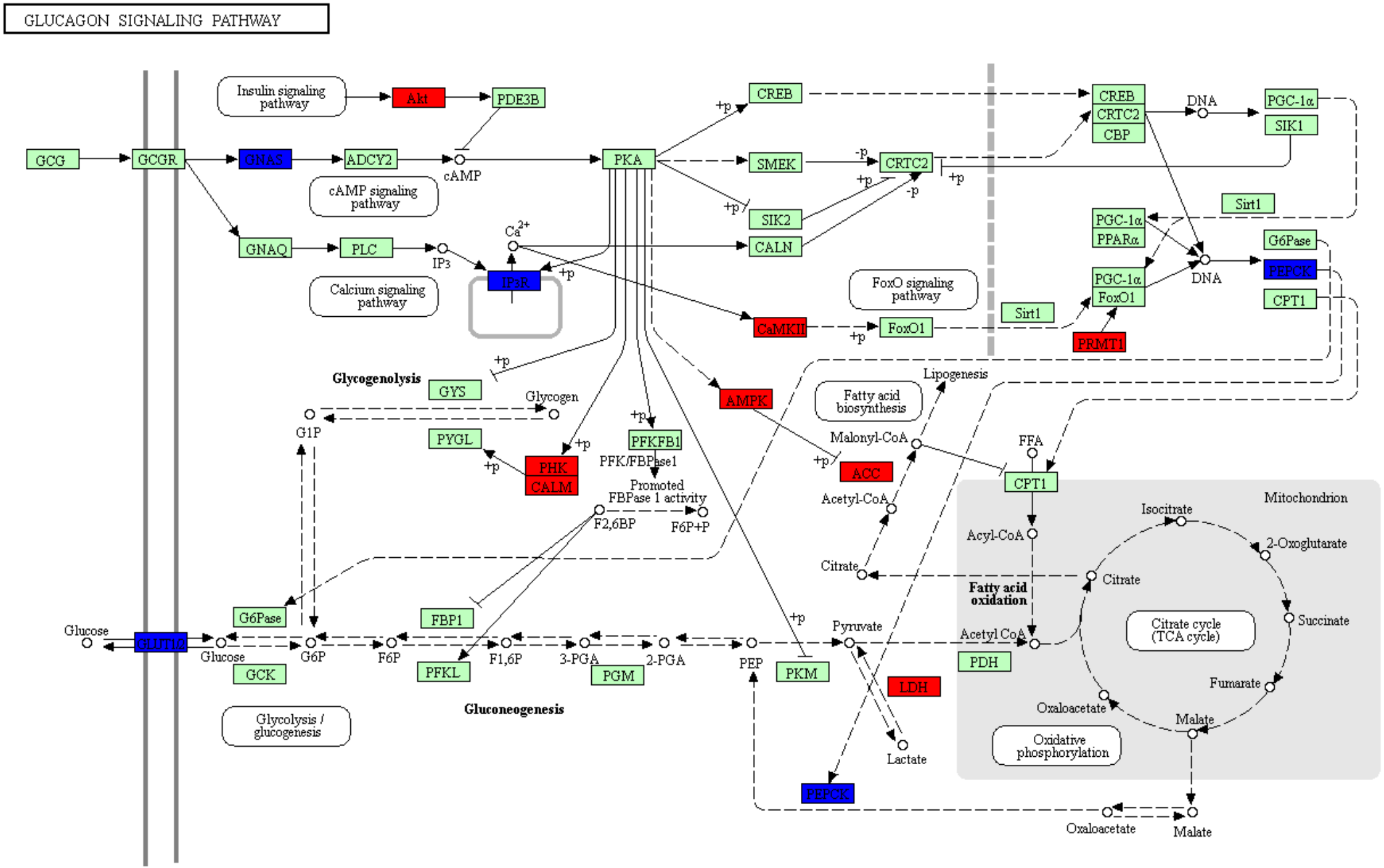

ESTROGEN SIGNALING PATHWAY
Ovarian steroidogenesis
E2
Membrane-initiated steroid signaling
ER
GPER
Gβγ
Gα
Gs
c-Src
MMP
(Pro-)HB-EGF
HB-EGF
AC
cAMP
PKA
EGFR
Shc
Grb2
SOS
Ras
Raf
+p
MEK
ERK1/2
PI3K
Akt
(Cardiomyocyte, neuron) Cell survival
MAPK signaling pathway
Nuclear-initiated steroid signaling
Hsp90
FKBP52
Hsp70
ER CoA
DNA
pCREB
BCL2
EBAG9
KRT19
CTSD
TFF1
PGR
TGFα
RARα
TF
GABA
GABAB
Gi/o
GABAergic synapse
GIRK
K+
(Proopiomelanocortin neuron) Increase of neuronal firing
βEnd
μ
PKCδ
DAG
mER
Gq
PLC
IP3
IP3R
Ca2+
CAM
Calcium signaling pathway
Membrane-initiated steroid signaling
mGluR1a
PI3K-Akt signaling pathway
eNOS
NO
SNO
(Cardiomyocyte) Cell survival
(Vascular smooth muscle) Relaxation
Vascular smooth muscle contraction
Target genes:
Cell cycle regulators
Pro-apoptotic proteins
Cell adhesion molecules
Components of the membrane and cytoplasmic signaling cascade

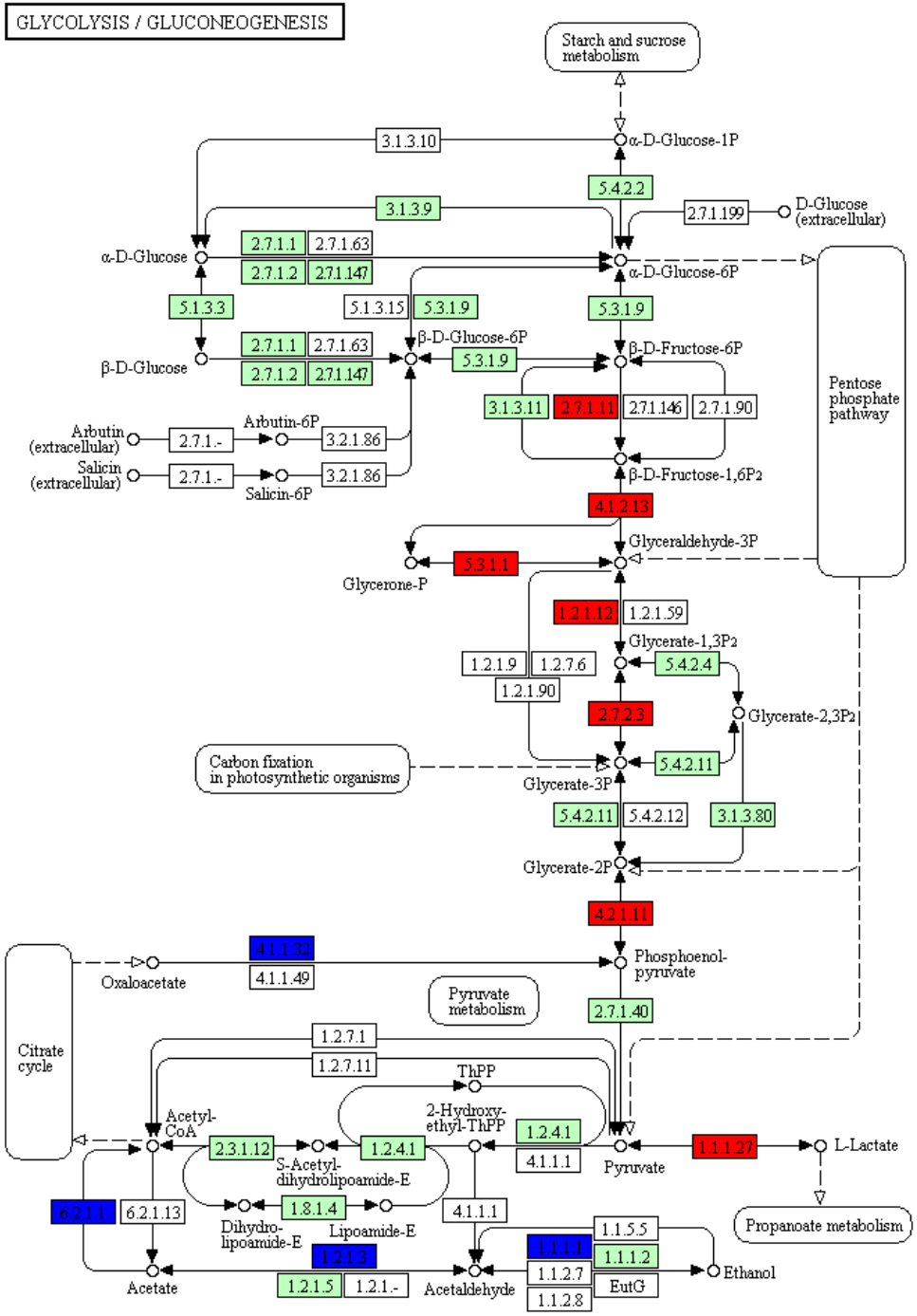

DILATED CARDIOMYOPATHY (DCM)
Viral infection
Autoimmunity
Extracellular matrix (ECM)
ECM-receptor interaction
Laminin
Viral myocarditis
Cardiac-specific autoantibody
IgG
Integrins
α-DAG
Dystroglycan complex
ITGA
ITGB
SGCD
SGCG
SGCA
SGCB
β-DAG
Sarcolemma
β1AR
NCX
Sarcoglycan complex
Cardiac myocyte
Gs
AC
cAMP
PKA
Na+
DMD
Desmin
ACTG1
ACTG1
T-tubule
+p
+p
+p
PLN
SERCA2a
Sarcomere
Cardiac muscle contraction
DHPR
RyR
Sarcoplasmic reticulum (SR)
Titin
TnC
TnI
Desmin
Emerin
LaminA/C
Nucleus
Impaired intracellular Ca2+ homeostasis
LV remodelling
TGFβ- signaling pathway
Renin-angiotensin system
Activation of:
TNF-α
IGF-1
TGF-β
Angiotensin II
ACTC1
TnT
MYL3
MYL2
MYH6
MYBPC
Cytoskeletal protein mutation
Defective force transmission
LV chamber dilation
Heart failure
Genetic predisposition
Sarcomeric/intrasarcomeric protein mutation
Impaired Ca2+ sensitivity
Defective force generation
Left venticular (LV) systolic dysfunction

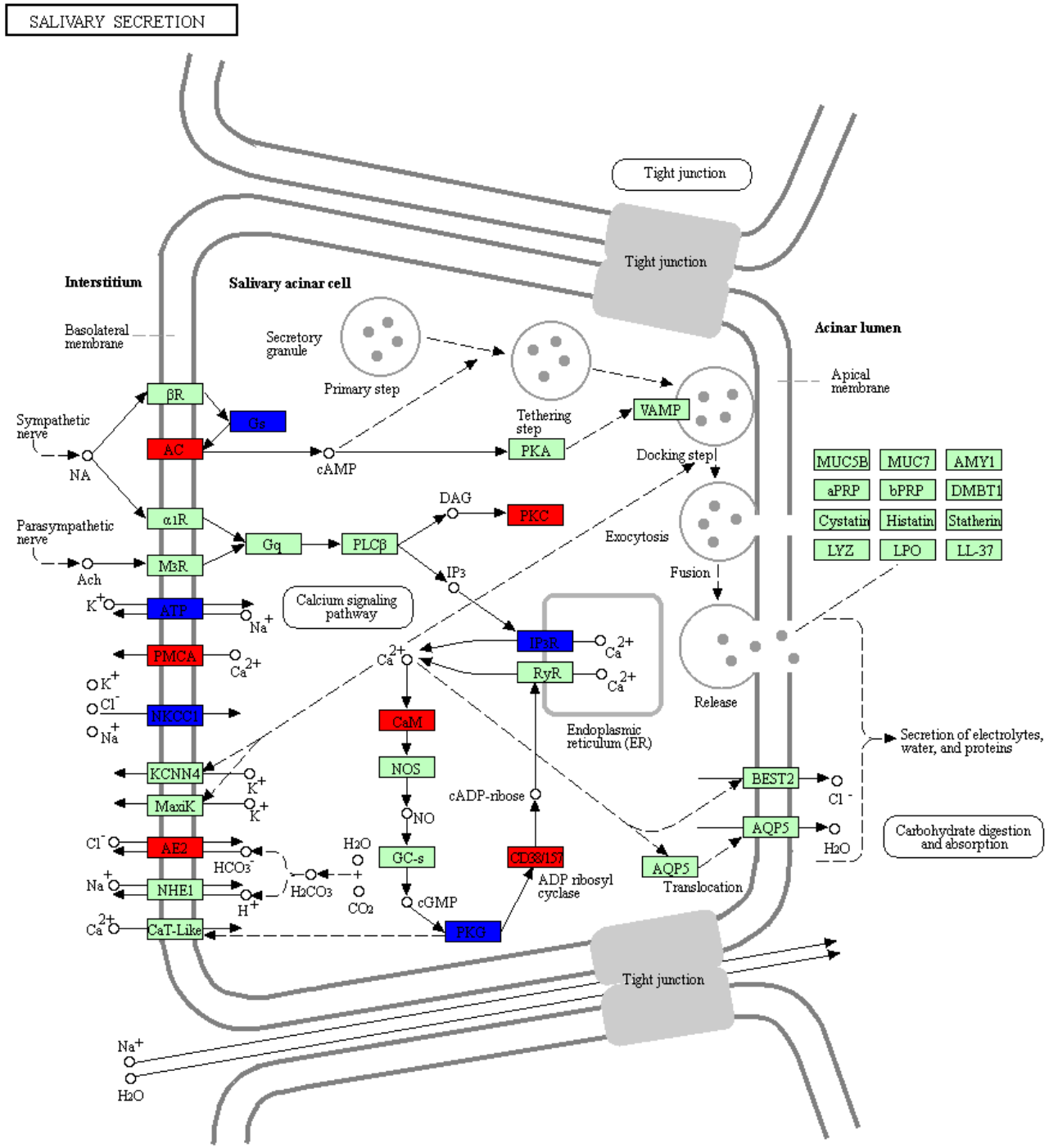
HYPERTROPHIC CARDIOMYOPATHY (HCM)

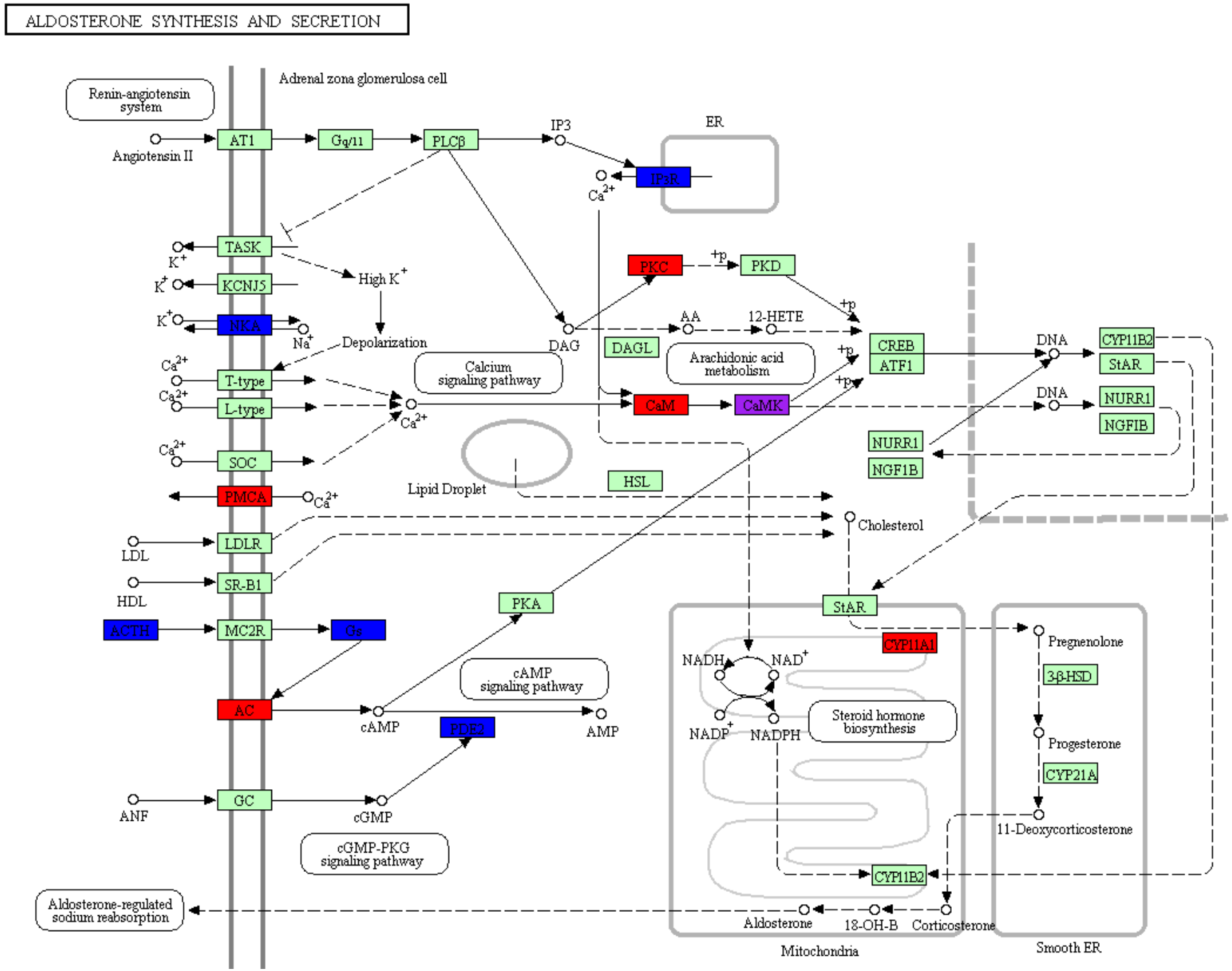


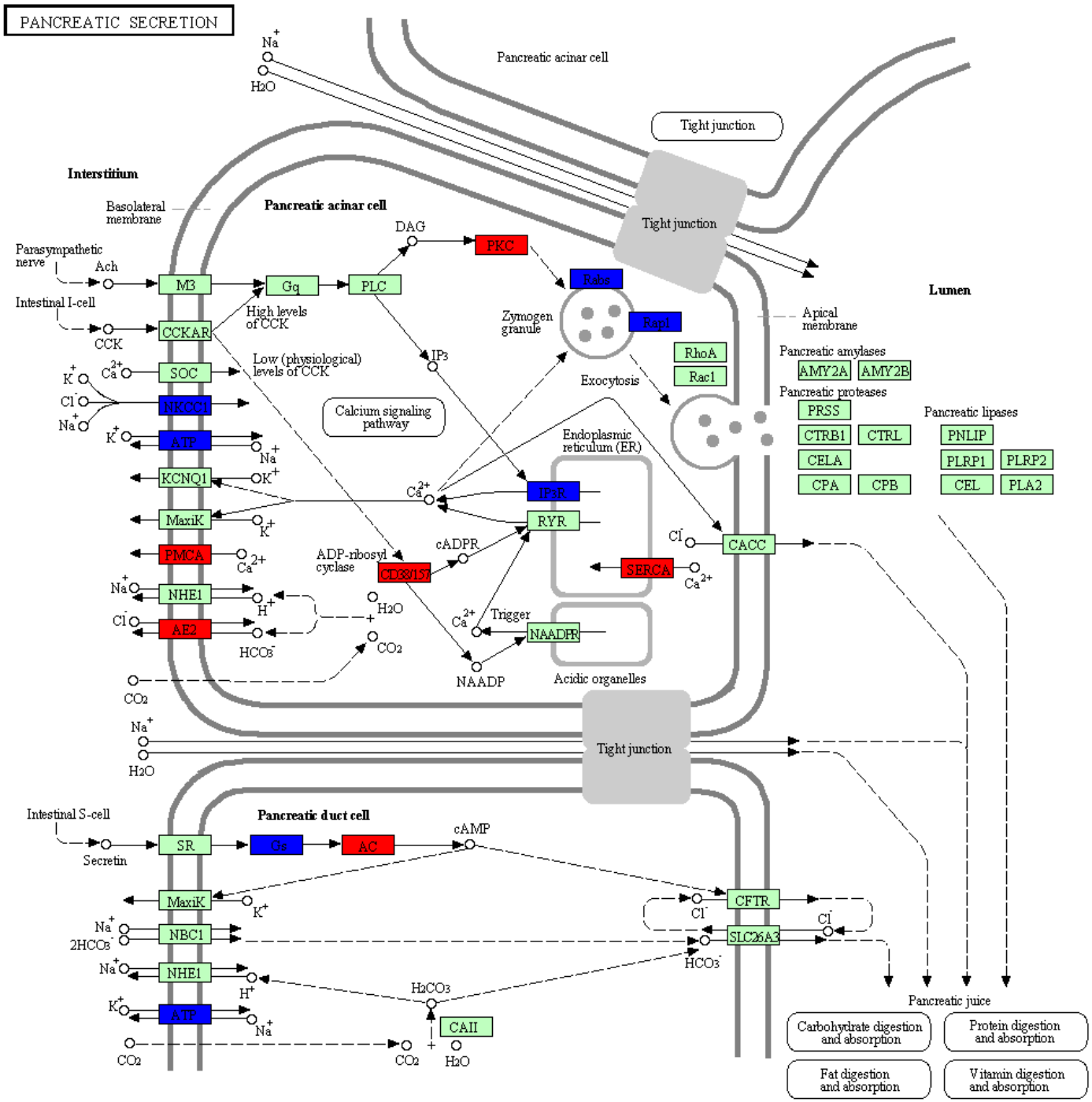

CIRCADIAN ENTRAINMENT
Postsynaptic suprachiasmatic nucleus (SCN) neuron
Early night
Light
AMPAR
Na+
NMDAR
T-VDCC
Ca2+
CaM
CaMKII
+p
nNOS
NO
CAPON
Dexras1
Gi/o
ERK
MAPK signaling pathway
MSK1
CREB
DNA
Phase delay
IP3R
RyR
ER
Presynaptic RGC neuron
L-Glutamate
PAC1
Gs
AC
cAMP
PKA
Circadian rhythm
Per
c-Fos
Clock genes
Immediate early genes
Late night
PACAP
GC
cGMP
PKG
L-VDCC
Gβγ
Gαs
Phase advance
Dusk and dawn
Pineal gland
Melatonin
MT2
MT1
Gi
Gq
PLC
DAG
PKC
Protein kinase cascades
Kir3
K+
Inhibition of neuronal firing
Sleep induction


GLUCAGON SIGNALING PATHWAY
Insulin signaling pathway
Akt
PDE3B
GCG
GCGR
GNAS
ADCY2
cAMP
cAMP signaling pathway
PKA
CREB
SMEK
SIK2
CRTC2
CALN
CREB
CRTC2
CBP
DNA
PGC-1α
SIK1
Sirt1
PGC-1α
PPARα
G6Pase
PEPCK
CPT1
GNAQ
PLC
IP3
IP3R
Ca2+
Calcium signaling pathway
FoxO signaling pathway
CaMKII
FoxO1
Sirt1
PGC-1α
FoxO1
PRMT1
DNA
Glycogenolysis
GYS
Glycogen
G1P
PYGL
PHK
CALM
PFKFB1
PFK/FBPase1
Promoted FBPase 1 activity
F2,6BP
F6P+P
AMPK
Fatty acid biosynthesis
Lipogenesis
Malonyl-CoA
ACC
Acetyl-CoA
FFA
CPT1
Mitochondrion
Isocitrate
2-Oxoglutarate
Acyl-CoA
Citrate
Fatty acid oxidation
Citrate
Citrate cycle (TCA cycle)
Succinate
Acetyl CoA
PDH
Fumarate
Oxaloacetate
Malate
Oxidative phosphorylation
Glucose
GLUT1/3
Glucose
G6P
F6P
F1,6P
3-PGA
2-PGA
PEP
PKM
Pyruvate
LDH
Lactate
G6Pase
FBP1
GCK
PFKL
PGM
Glycolysis / glucogenesis
Gluconeogenesis
PEPCK
Oxaloacetate
Malate

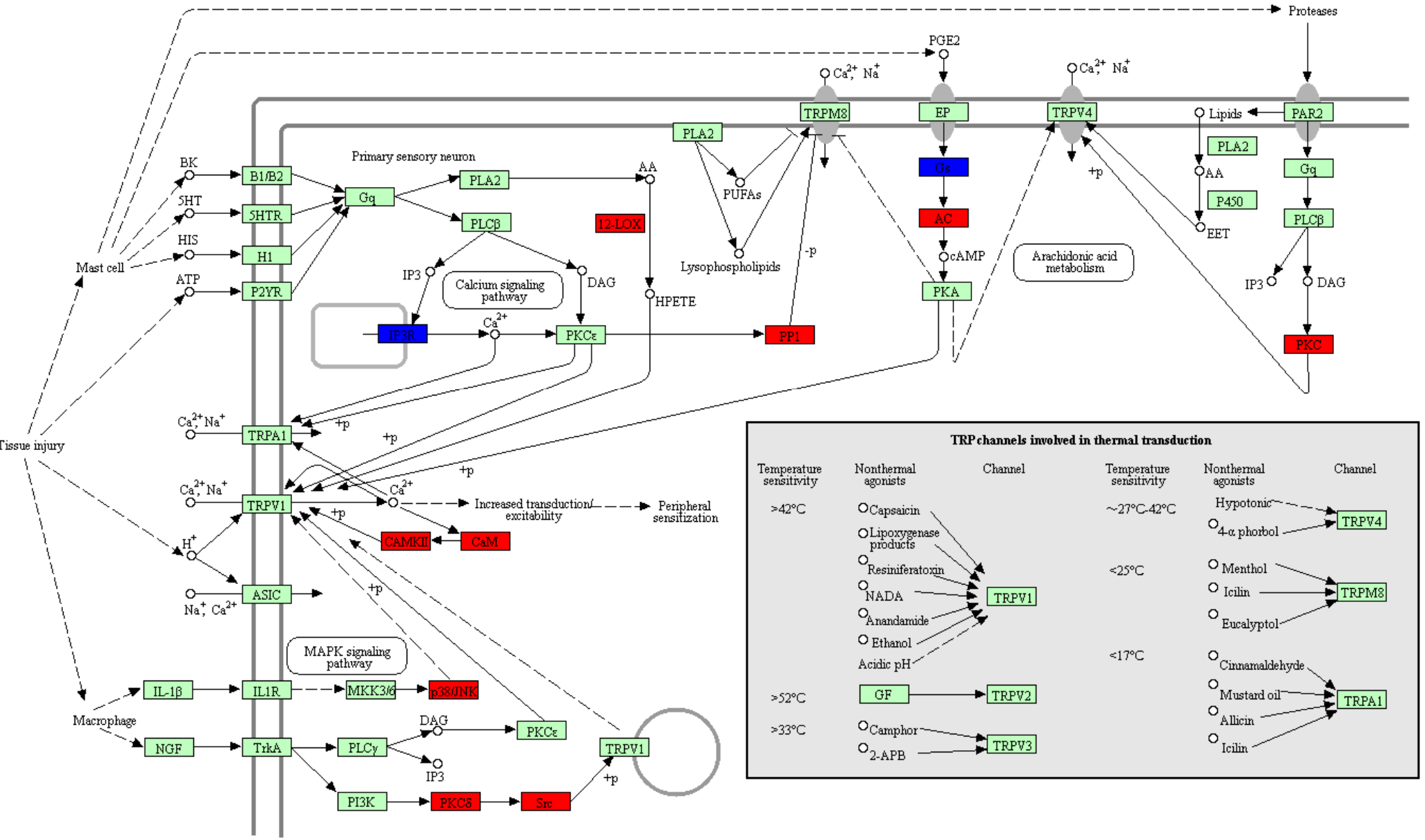

GLYCOLYSIS / GLUCONEOGENESIS
Starch and sucrose metabolism
α-D-Glucose-1P
3.1.3.10
5.4.2.2
3.1.3.9
2.7.1.199
D-Glucose (extracellular)
α-D-Glucose
2.7.1.1
2.7.1.63
2.7.1.2
2.7.1.147
α-D-Glucose-6P
5.1.3.3
5.1.3.15
5.3.1.9
β-D-Glucose-6P
β-D-Glucose
β-D-Fructose-6P
Pentose phosphate pathway
3.1.3.11
2.7.1.11
2.7.1.146
2.7.1.90
Arbutin (extracellular)
2.7.1.-
Arbutin-6P
3.2.1.86
Salicin (extracellular)
Salicin-6P
β-D-Fructose-1,6P2
4.1.2.13
Glyceraldehyde-3P
5.3.1.1
Glycerone-P
1.2.1.12
1.2.1.59
Glycerate-1,3P2
1.2.1.9
1.2.7.6
1.2.1.90
5.4.2.4
2.7.2.3
Glycerate-2,3P2
Carbon fixation in photosynthetic organisms
5.4.2.11
Glycerate-3P
5.4.2.11
5.4.2.12
3.1.3.80
Glycerate-2P
4.2.1.11
Phosphoenol-pyruvate
4.1.1.32
4.1.1.49
Oxaloacetate
Pyruvate metabolism
2.7.1.40
Citrate cycle
1.2.7.1
1.2.7.11
ThPP
Acetyl-CoA
2-Hydroxy-ethyl-ThPP
2.3.1.12
1.2.4.1
1.2.4.1
4.1.1.1
1.1.1.27
L-Lactate
Pyruvate
S-Acetyl-dihydrolipoamide-E
6.2.1.1
6.2.1.13
1.8.1.4
4.1.1.1
Dihydro-lipoamide-E
Lipoamide-E
Propanoate metabolism
1.1.5.5
1.1.1.1
1.1.1.2
1.2.1.3
1.1.2.7
EutG
Ethanol
Acetate
1.2.1.5
1.2.1.-
Acetaldehyde
1.1.2.8


SALIVARY SECRETION
Tight junction
Tight junction
Interstitium
Salivary acinar cell
Acinar lumen
Basolateral membrane
Apical membrane
Secretory granule
Primary step
Tethering step
Docking step
Exocytosis
Fusion
Release
Sympathetic nerve
NA
βR
Gs
AC
cAMP
PKA
VAMP
Parasympathetic nerve
Ach
α1R
M3R
Gq
PLCβ
DAG
PKC
IP3
Calcium signaling pathway
ATP
PMCA
NKCC1
KCNN4
MaxiK
AE2
NHE1
CaT-Like
IP3R
RyR
Endoplasmic reticulum (ER)
CaM
NOS
NO
GC-s
cGMP
PKG
cADP-ribose
CD38/157
ADP ribosyl cyclase
AQP5
Translocation
BEST2
AQP5
Secretion of electrolytes, water, and proteins
Carbohydrate digestion and absorption
MUC5B
MUC7
AMY1
aPRP
bPRP
DMBT1
Cystatin
Histatin
Statherin
LYZ
LPO
LL-37
Tight junction
Na+
H2O

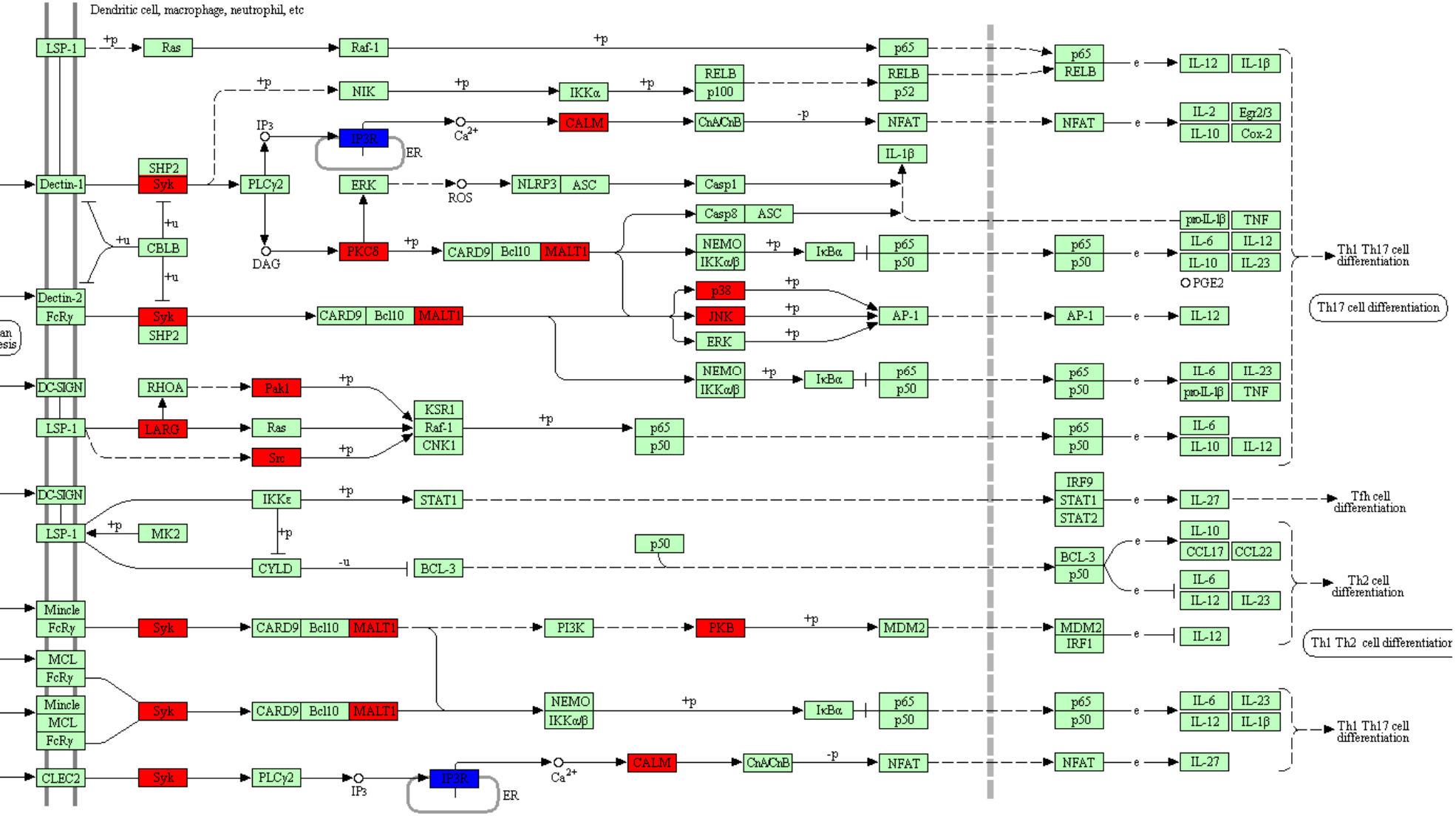

ALDOSTERONE SYNTHESIS AND SECRETION
Adrenal zona glomerulosa cell
Renin-angiotensin system
Angiotensin II
AT1
Gq/11
PLCβ
IP3
ER
IP3R
Ca2+
TASK
K+
KCNJ5
High K+
NKA
Na+
Depolarization
PKC
+p
PKD
AA
12-HETE
DAG
DAGL
Arachidonic acid metabolism
Calcium signaling pathway
CREB
ATF1
DNA
CYP11B2
StAR
NURR1
NGFIB
T-type
L-type
SOC
CaM
CaMK
Lipid Droplet
HSL
PMCA
Cholesterol
LDL
LDLR
HDL
SR-B1
ACTH
MC2R
Gs
PKA
StAR
CYP11A1
NADH
NAD+
NADP+
NADPH
Steroid hormone biosynthesis
Pregnenolone
3β-HSD
Progesterone
CYP21A
11-Deoxycorticosterone
cAMP signaling pathway
AC
cAMP
PDE2
AMP
ANF
GC
cGMP
cGMP-PKG signaling pathway
CYP11B2
Aldosterone-regulated sodium reabsorption
Aldosterone
18-OH-B
Corticosterone
Mitochondria
Smooth ER

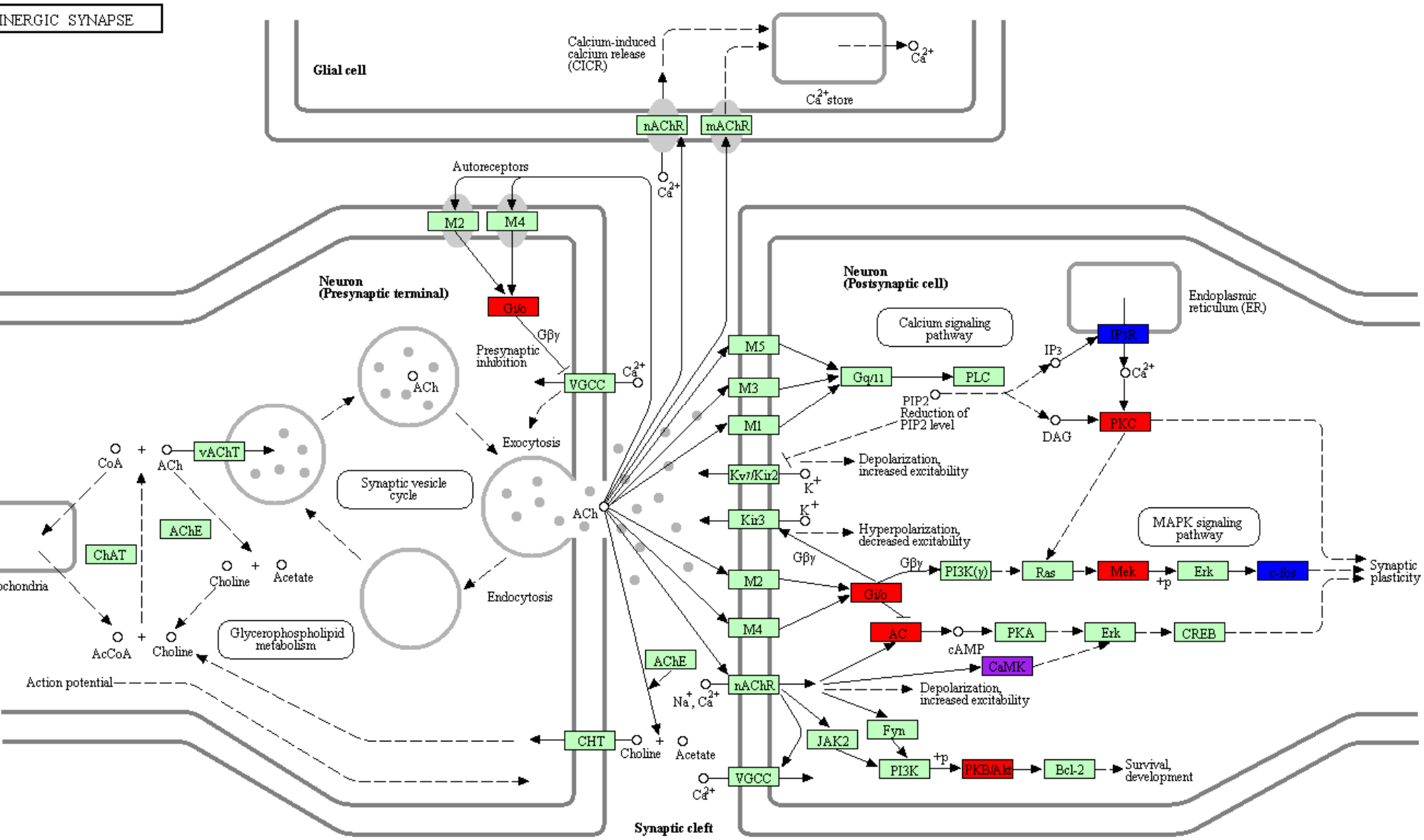

PANCREATIC SECRETION
Pancreatic acinar cell
Tight junction
Interstitium
Basolateral membrane
Pancreatic acinar cell
Lumen
Apical membrane
Parasympathetic nerve
Ach
Intestinal I-cell
CCK
M3
CCKAR
Gq
PLC
DAG
PKC
High levels of CCK
Low (physiological) levels of CCK
IP3
Calcium signaling pathway
Zymogen granule
Rabs
Rap1
RhoA
Rac1
Exocytosis
Pancreatic amylases
AMY2A
AMY2B
Pancreatic proteases
PRSS
CTRB1
CTRL
CELA
CPA
CPB
Pancreatic lipases
PNLIP
PLRP1
PLRP2
CEL
PLA2
SOC
NKCC1
ATP
KCNQ1
MaxiK
PMCA
NHE1
AE2
Endoplasmic reticulum (ER)
IP3R
RYR
SERCA
CACC
ADP-ribosyl cyclase
CD38/157
cADPR
NAADP
NAADPR
Trigger
Acidic organelles
Tight junction
Intestinal S-cell
Secretin
Pancreatic duct cell
SR
Gs
AC
cAMP
MaxiK
NBC1
NHE1
ATP
CFTR
SLC26A3
CAII
Pancreatic juice
Carbohydrate digestion and absorption
Protein digestion and absorption
Fat digestion and absorption
Vitamin digestion and absorption

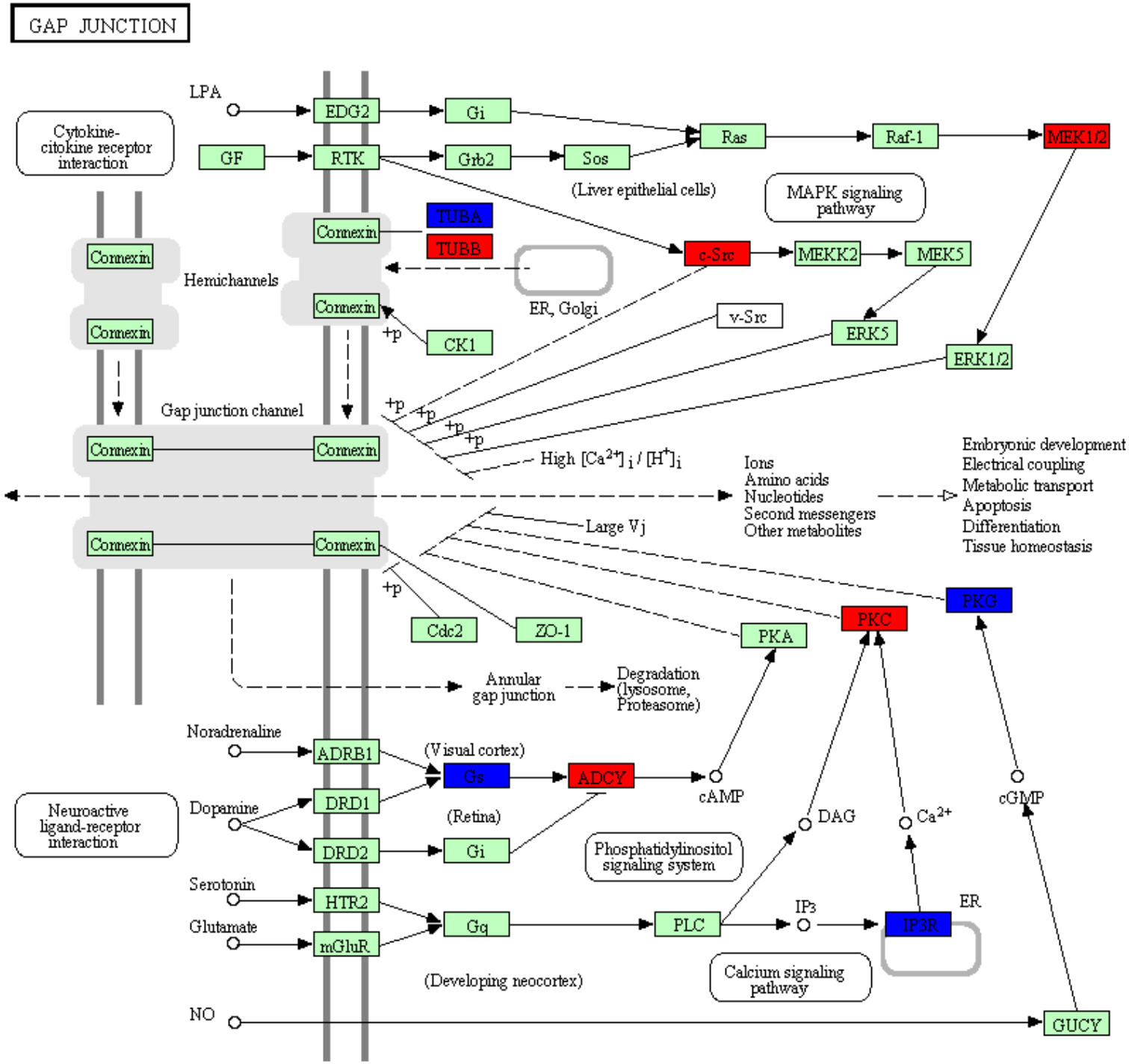
INFLAMMATORY MEDIATOR REGULATION OF TRP CHANNELS

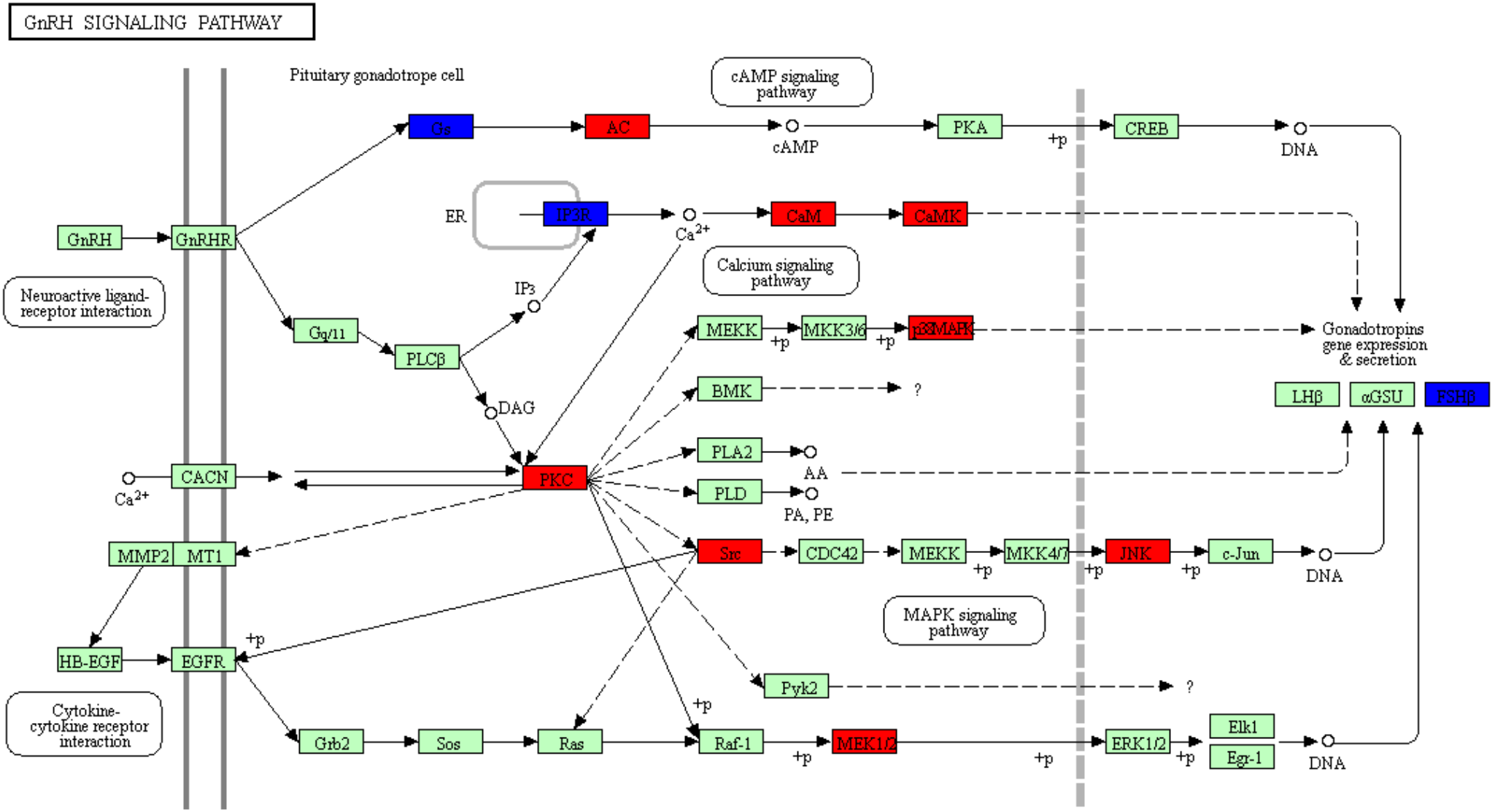


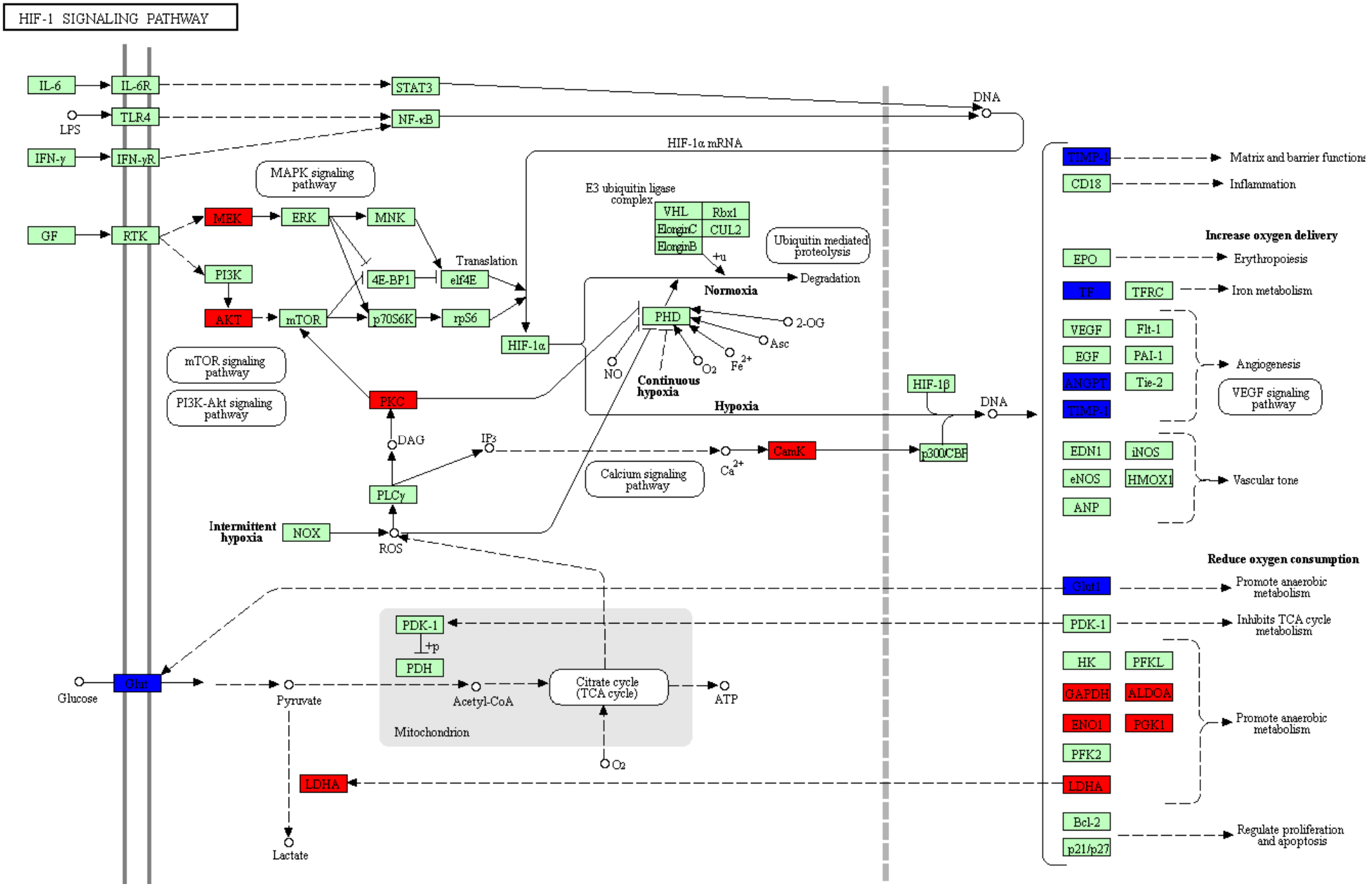
CTIN RECEPTOR SIGNALING PATHWAY

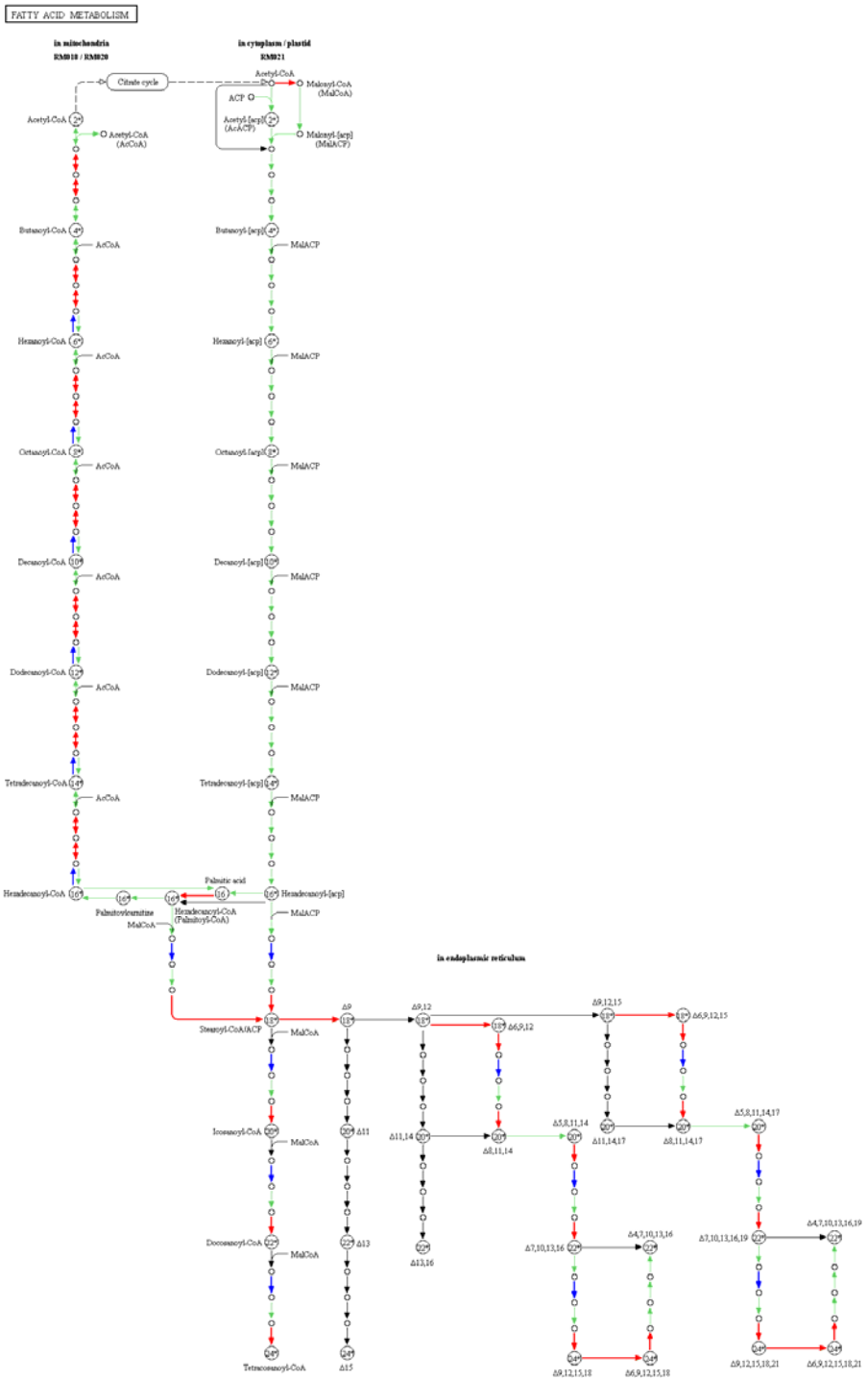



INERGIC SYNAPSE
Glial cell
Calcium-induced calcium release (CICR)
Ca2+
Ca2+ store
nAChR
mAChR
Autoreceptors
Ca2+
M2
M4
Neuron (Presynaptic terminal)
Gi/o
Gβγ
Presynaptic inhibition
VGCC
Ca2+
ACh
Exocytosis
vAChT
CoA
ACh
Synaptic vesicle cycle
AChE
ChAT
Choline
Acetate
Endocytosis
AcCoA
Choline
Glycerophospholipid metabolism
Action potential
ochondria
Neuron (Postsynaptic cell)
Calcium signaling pathway
Endoplasmic reticulum (ER)
IP3R
IP3
Ca2+
M5
M3
M1
Gq/11
PLC
PIP2
Reduction of PIP2 level
DAG
PKC
Depolarization, increased excitability
Kv7/Kir2
K+
Kir3
K+
Hyperpolarization, decreased excitability
MAPK signaling pathway
Gβγ
Gβγ
PI3K(γ)
Ras
Mek
+p
Erk
c-fos
Synaptic plasticity
M2
M4
Gi/o
AC
PKA
Erk
CREB
cAMP
CaMK
AChE
nAChR
Na+, Ca2+
Depolarization, increased excitability
Fyn
JAK2
PI3K
+p
PKB/Akt
Bcl-2
Survival, development
CHT
Choline
Acetate
VGCC
Ca2+
Synaptic cleft

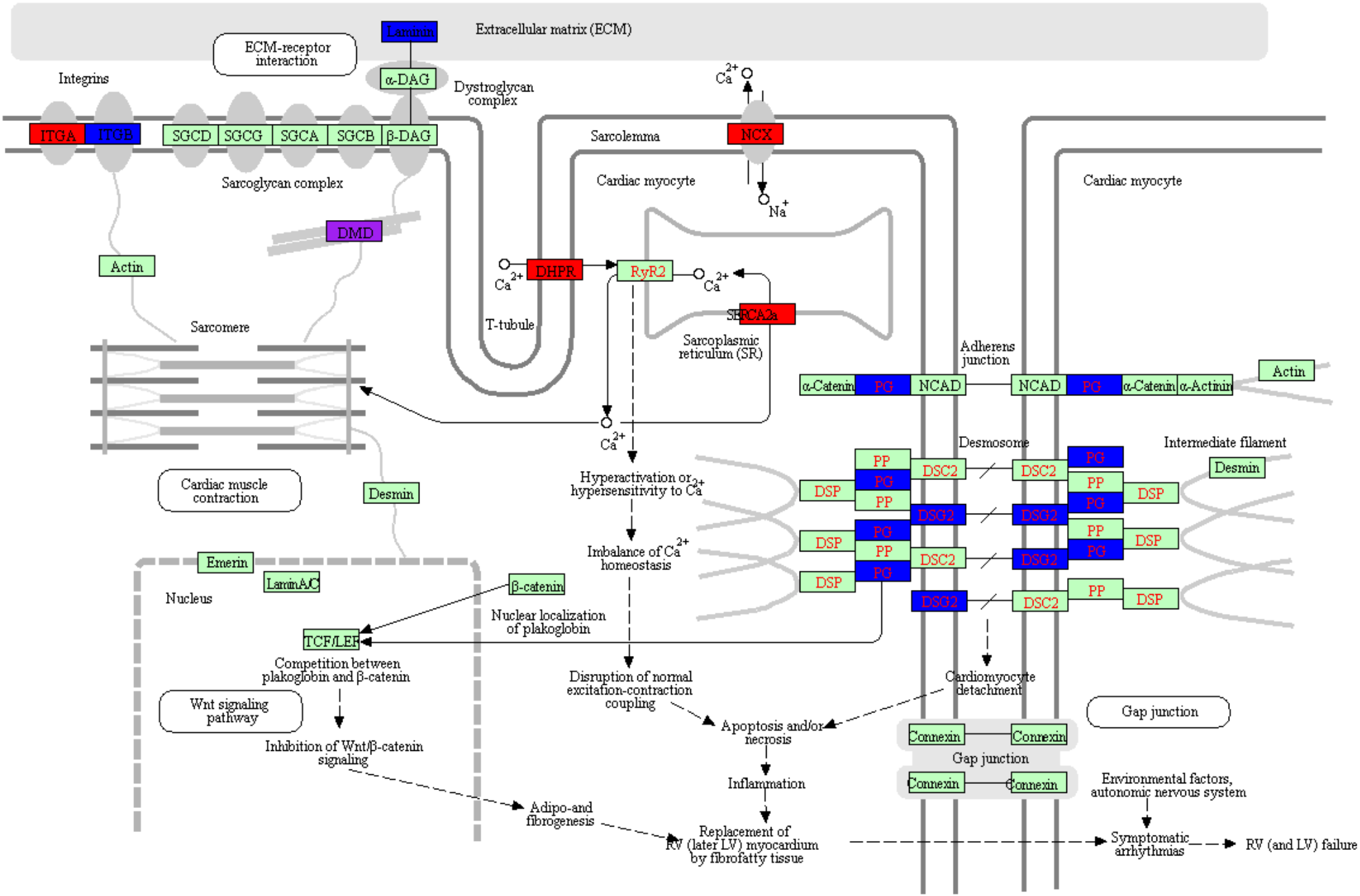

GAP JUNCTION
LPA
EDG2
Gi
Ras
Raf-1
MEK1/2
Cytokine-
citokine receptor
interaction
GF
RTK
Grb2
Sos
(Liver epithelial cells)
MAPK signaling
pathway
Connexin
TUBA
TUBB
c-Src
MEKK2
MEK5
Hemichannels
ER, Golgi
v-Src
ERK5
+p
CK1
ERK1/2
Gap junction channel
High [Ca2+]i / [H+]i
Ions
Amino acids
Nucleotides
Second messengers
Other metabolites
Embryonic development
Electrical coupling
Metabolic transport
Apoptosis
Differentiation
Tissue homeostasis
Large Vj
PKG
PKC
PKA
Cdc2
ZO-1
Annular
gap junction
Degradation
(lysosome,
Proteasome)
Noradrenaline
ADRB1
(Visual cortex)
Gs
ADCY
cAMP
Dopamine
DRD1
DRD2
(Retina)
Gi
Neuroactive
ligand-receptor
interaction
Phosphatidylinositol
signaling system
DAG
Ca2+
cGMP
Serotonin
HTR2
Glutamate
mGluR
Gq
PLC
IP3
IP3R
ER
Calcium signaling
pathway
(Developing neocortex)
NO
GUCY

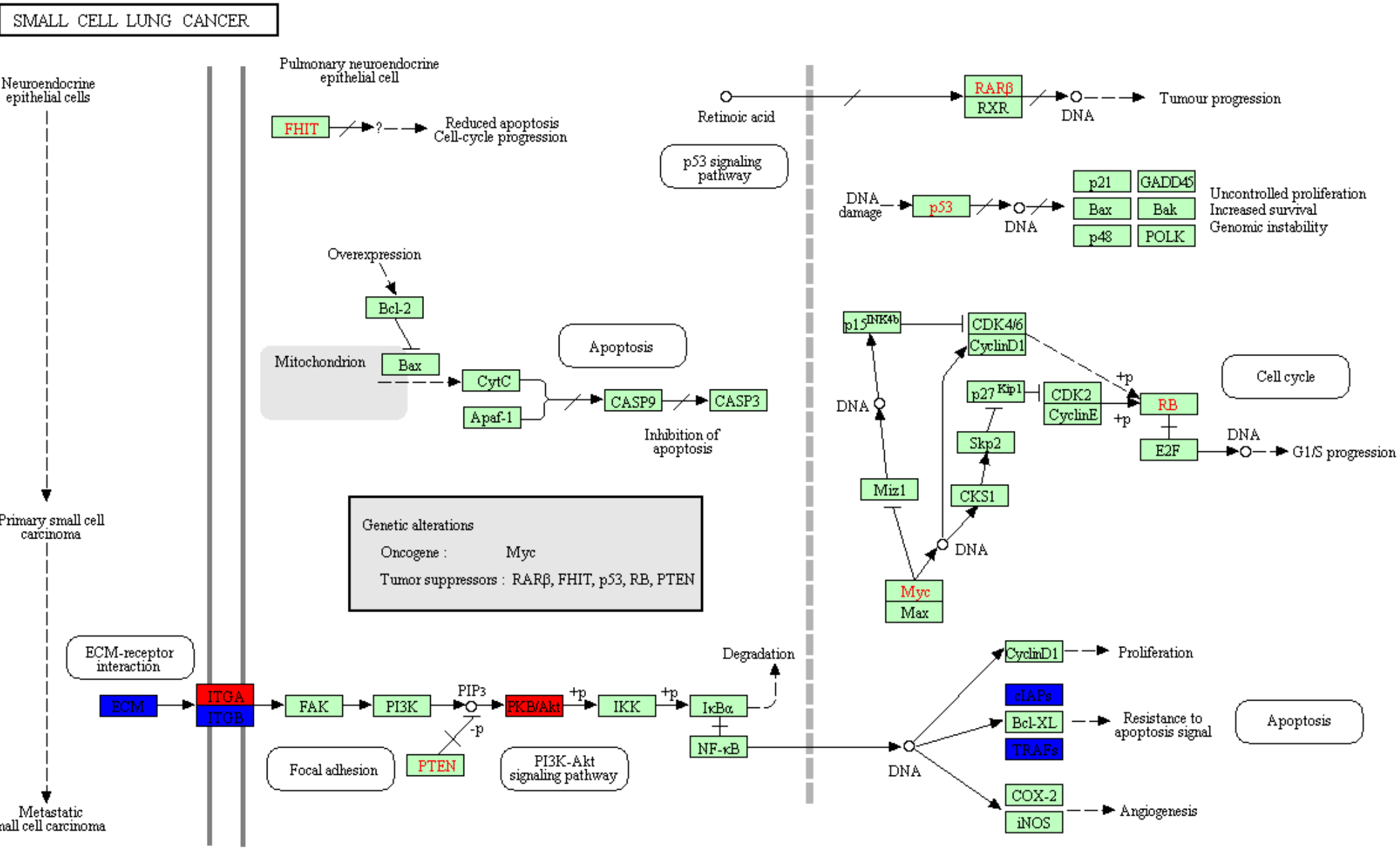

GnRH SIGNALING PATHWAY
Pituitary gonadotrope cell
cAMP signaling pathway
Calcium signaling pathway
MAPK signaling pathway
Neuroactive ligand-receptor interaction
Cytokine-cytokine receptor interaction
GnRH
GnRHR
Gs
AC
cAMP
PKA
+p
CREB
DNA
ER
IP3R
Ca2+
CaM
CaMK
IP3
Gq/11
PLCβ
DAG
MEKK
MKK3/6
+p
+p
Gonadotropins gene expression & secretion
BMK
?
LHβ
αGSU
FSHβ
PLA2
AA
PKC
Ca2+
CACN
PLD
PA, PE
MMP2
MT1
Src
CDC42
MEKK
MKK4/7
JNK
c-Jun
+p
+p
+p
DNA
HB-EGF
EGFR
+p
Pyk2
?
+p
Grb2
Sos
Ras
Raf-1
MEK1/2
ERK1/2
Elk1
Egr-1
+p
+p
+p
DNA

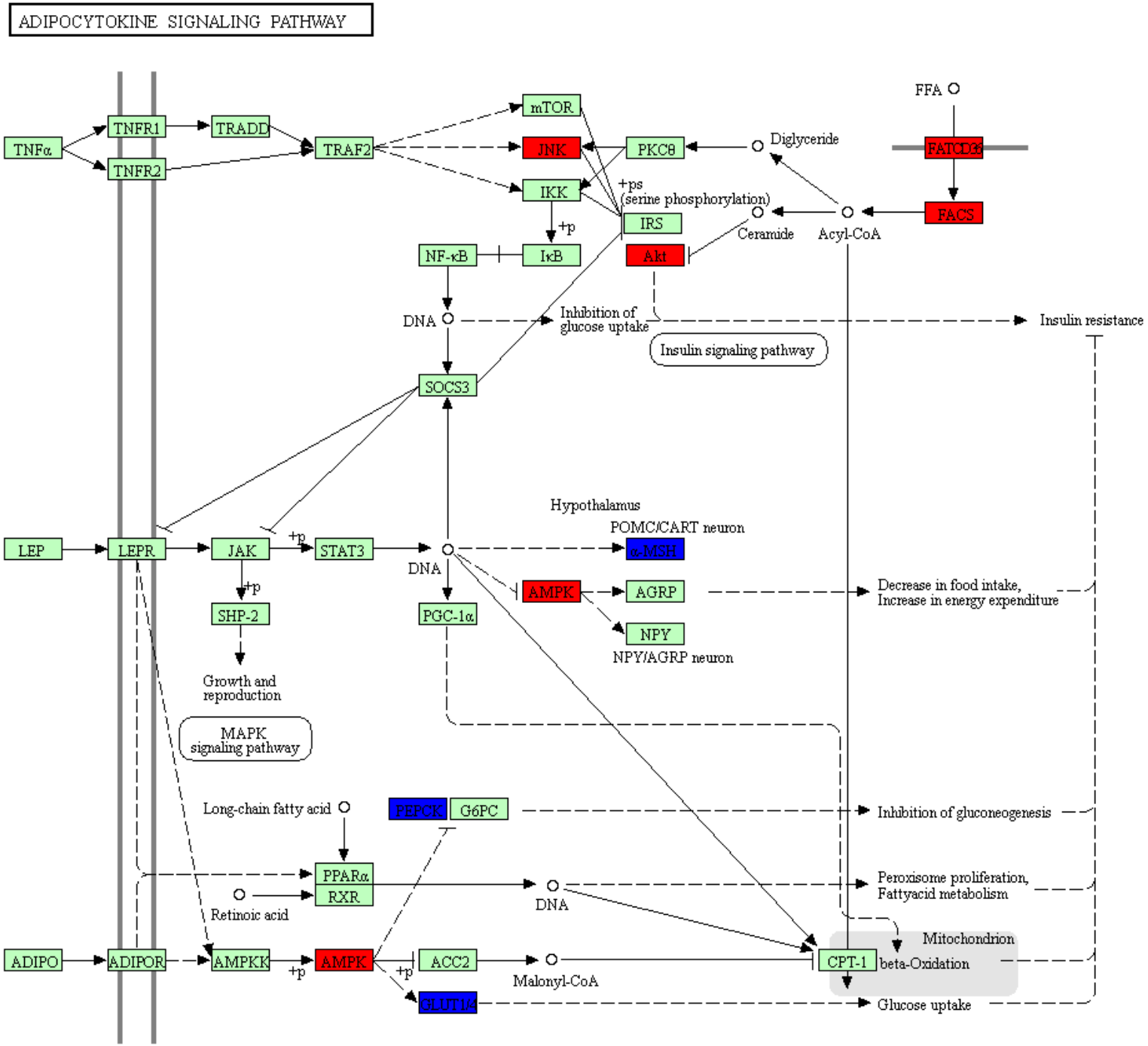

HIF-1 SIGNALING PATHWAY
IL-6
IL-6R
STAT3
DNA
LPS
TLR4
NF-κB
IFN-γ
IFN-γR
HIF-1α mRNA
MAPK signaling pathway
E3 ubiquitin ligase complex
VHL
Rbx1
ElonginC
CUL2
ElonginB
+u
Ubiquitin mediated proteolysis
GF
RTK
MEK
ERK
MNK
Translation
4E-BP1
elf4E
Degradation
PI3K
Normoxia
AKT
mTOR
p70S6K
rpS6
PHD
2-OG
Asc
HIF-1α
NO
O2
Fe2+
mTOR signaling pathway
Continuous hypoxia
HIF-1β
DNA
PI3K-Akt signaling pathway
PKC
Hypoxia
DAG
IP3
CamK
p300/CBP
Ca2+
Calcium signaling pathway
PLCγ
Intermittent hypoxia
NOX
ROS
TIMP-1
Matrix and barrier functions
CD18
Inflammation
Increase oxygen delivery
EPO
Erythropoiesis
TF
TFRC
Iron metabolism
VEGF
Flt-1
EGF
PAI-1
ANGPT
Tie-2
TIMP-1
Angiogenesis
VEGF signaling pathway
EDN1
iNOS
eNOS
HMOX1
ANP
Vascular tone
Reduce oxygen consumption
Glut1
Promote anaerobic metabolism
PDK-1
Inhibits TCA cycle metabolism
PDK-1
+p
PDH
HK
PFKL
GAPDH
ALDOA
ENO1
PGK1
PFK2
Promote anaerobic metabolism
Glucose
Glut
Pyruvate
Acetyl-CoA
Citrate cycle (TCA cycle)
ATP
Mitochondrion
O2
LDHA
LDHA
Lactate
Bcl-2
p21/p27
Regulate proliferation and apoptosis


FATTY ACID METABOLISM
in mitochondria
RM018 / RM020
in cytoplasm / plastid
RM021
Citrate cycle
Acetyl-CoA
Malonyl-CoA (MalCoA)
ACP
Acetyl-[acp] (AcACP)
Malonyl-[acp] (MalACP)
Acetyl-CoA (AcCoA)
Butanoyl-CoA
Butanoyl-[acp]
Hexanoyl-CoA
Hexanoyl-[acp]
Octanoyl-CoA
Octanoyl-[acp]
Decanoyl-CoA
Decanoyl-[acp]
Dodecanoyl-CoA
Dodecanoyl-[acp]
Tetradecanoyl-CoA
Tetradecanoyl-[acp]
Hexadecanoyl-CoA
Hexadecanoyl-[acp]
Palmitic acid
Palmitoylcarnitine
Hexadecanoyl-CoA (Palmitoyl-CoA)
MalCoA
MalACP
in endoplasmic reticulum
Stearoyl-CoA(ACP)
Δ9
Δ9,12
Δ6,9,12
Δ9,12,15
Δ6,9,12,15
Icosanoyl-CoA
Δ11
Δ11,14
Δ8,11,14
Δ5,8,11,14
Δ11,14,17
Δ8,11,14,17
Δ5,8,11,14,17
Docosanoyl-CoA
Δ13
Δ13,16
Δ7,10,13,16
Δ4,7,10,13,16
Δ7,10,13,16,19
Δ4,7,10,13,16,19
Tetracosanoyl-CoA
Δ15
Δ9,12,15,18
Δ6,9,12,15,18
Δ9,12,15,18,21
Δ6,9,12,15,18,21

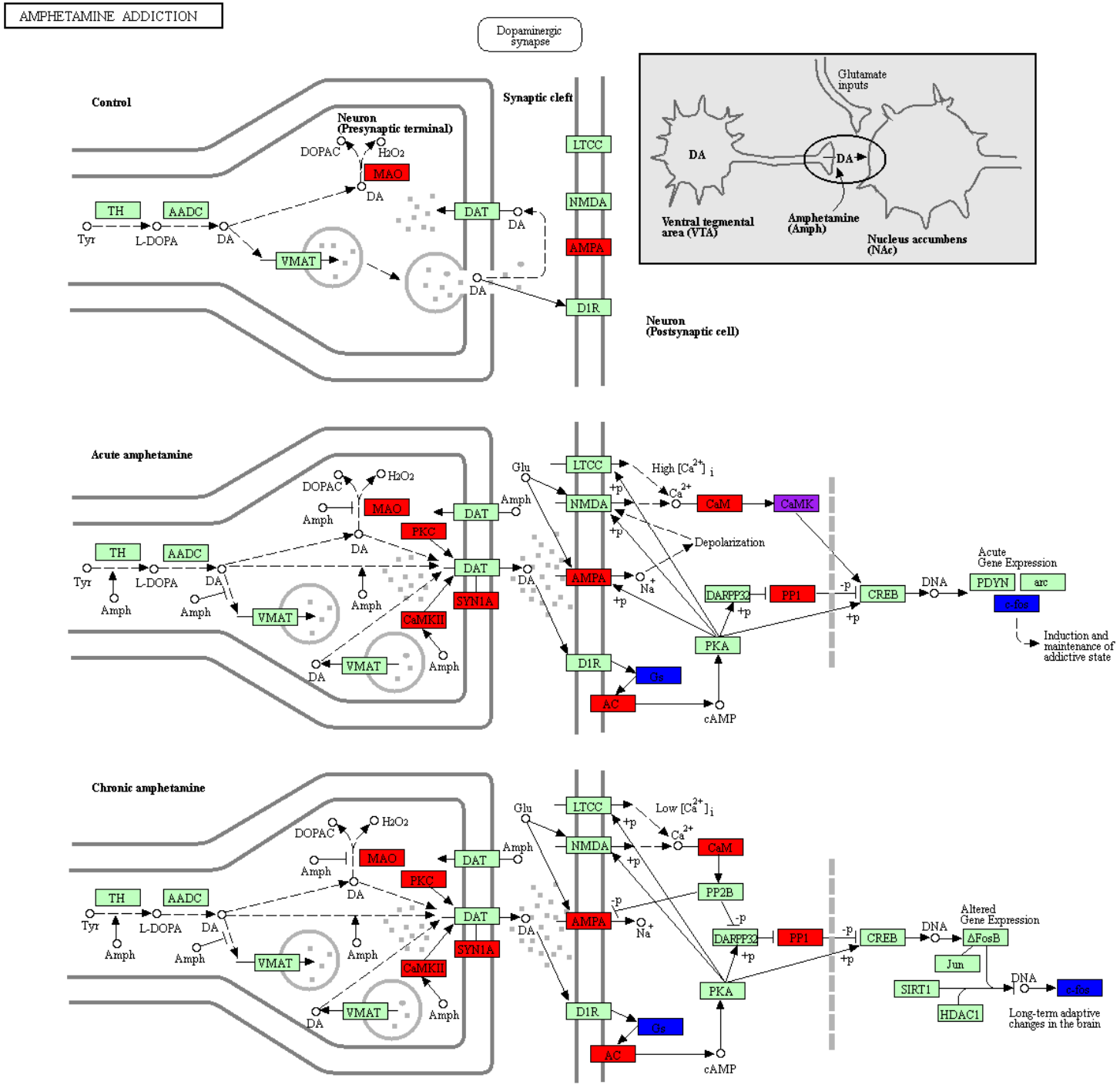
ARRHYTHMOGENIC RIGHT VENTRICULAR CARDIOMYOPATHY (ARVC)

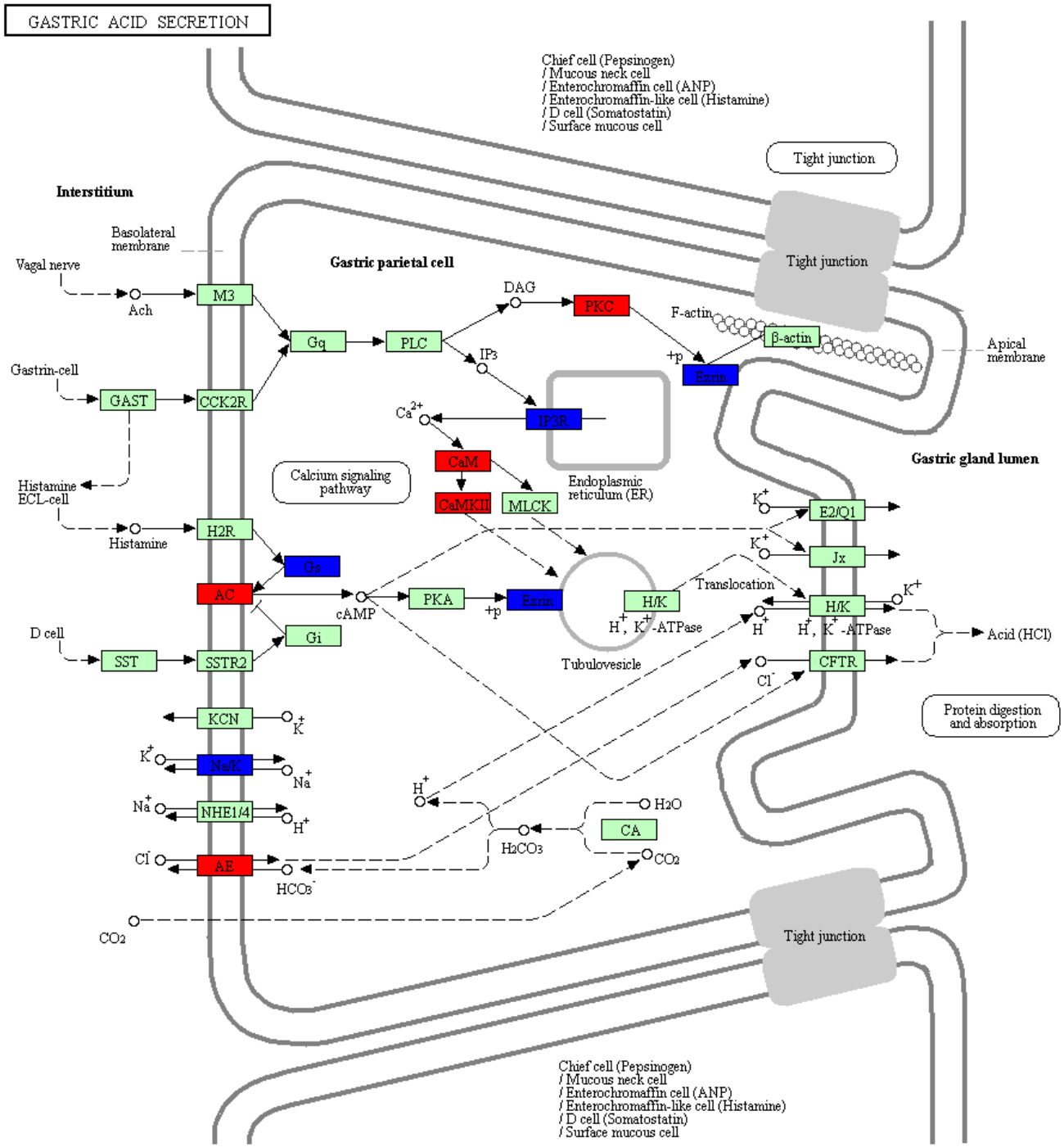


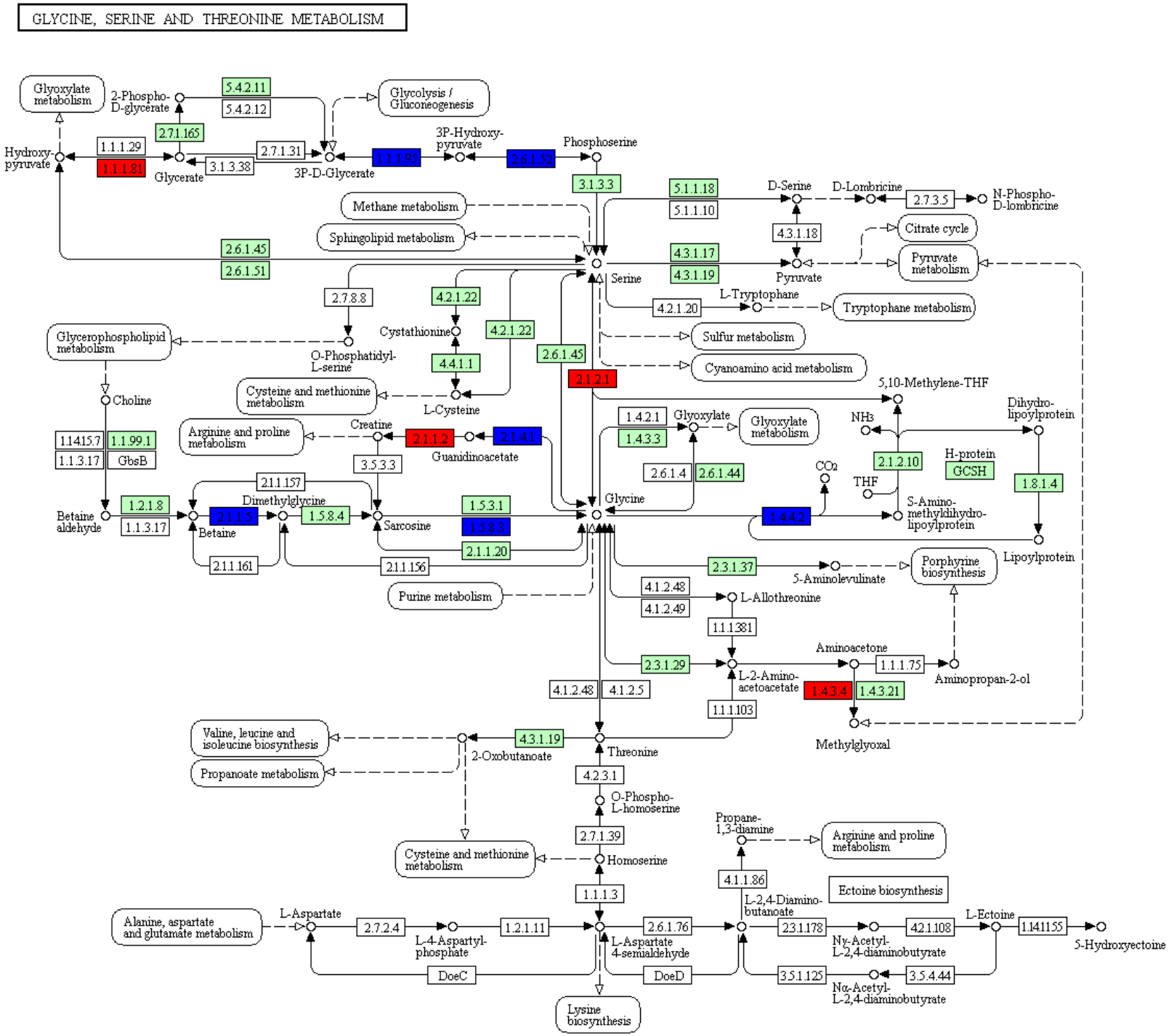

SMALL CELL LUNG CANCER
Neuroendocrine epithelial cells
Primary small cell carcinoma
Metastatic mall cell carcinoma
Pulmonary neuroendocrine epithelial cell
FHIT
?
Reduced apoptosis
Cell-cycle progression
Retinoic acid
RARβ
RXR
DNA
Tumour progression
p53 signaling pathway
DNA damage
p53
DNA
p21
GADD45
Bax
Bak
p48
POLK
Uncontrolled proliferation
Increased survival
Genomic instability
Overexpression
Bcl-2
Mitochondrion
Bax
Apoptosis
CytC
Apaf-1
CASP9
CASP3
Inhibition of apoptosis
p15INK4b
CDK4/6
CyclinD1
+p
Cell cycle
DNA
p27Kip1
CDK2
CyclinE
+p
RB
E2F
DNA
G1/S progression
Skp2
Miz1
CKS1
DNA
Myc
Max
Genetic alterations
Oncogene : Myc
Tumor suppressors : RARβ, FHIT, p53, RB, PTEN
ECM-receptor interaction
ECM
ITGA
ITGB
FAK
PI3K
PIP3
PKB/Akt
+p
IKK
+p
IκBα
Degradation
-p
PTEN
Focal adhesion
PI3K-Akt signaling pathway
NF-κB
DNA
CyclinD1
Proliferation
cIAPs
Bcl-XL
TRAFs
Resistance to apoptosis signal
Apoptosis
COX-2
iNOS
Angiogenesis

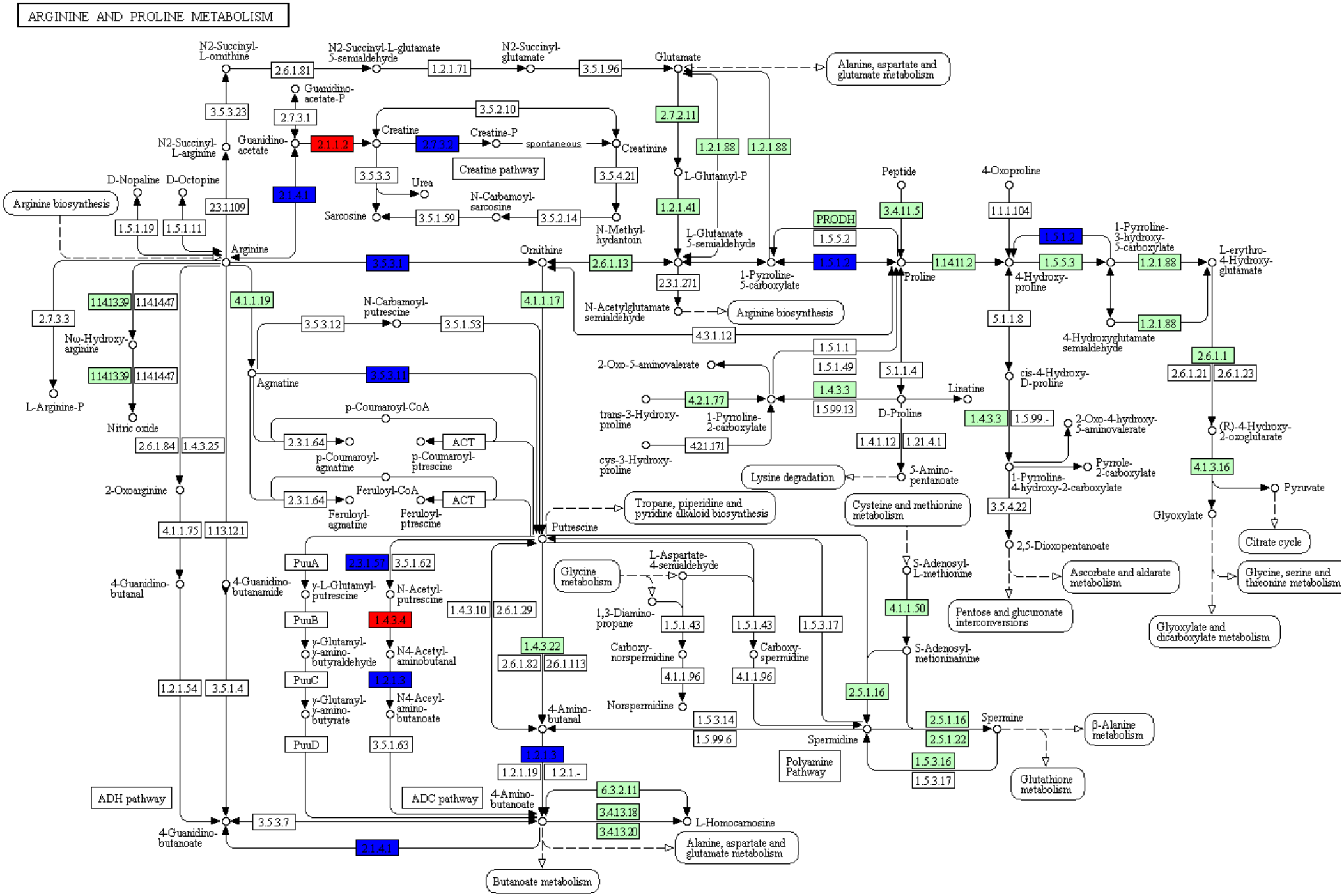

ADIPOCYTOKINE SIGNALING PATHWAY
TNFα
TNFR1
TNFR2
TRADD
TRAF2
mTOR
JNK
IKK
PKCθ
Diglyceride
FFA
FATCD36
FACS
+ps
(serine phosphorylation)
IRS
Ceramide
Acyl-CoA
+p
NF-κB
IκB
Akt
DNA
Inhibition of
glucose uptake
Insulin resistance
Insulin signaling pathway
SOCS3
Hypothalamus
POMC/CART neuron
LEP
LEPR
JAK
+p
STAT3
DNA
α-MSH
AMPK
AGRP
NPY
NPY/AGRP neuron
Decrease in food intake,
Increase in energy expenditure
+p
SHP-2
PGC-1α
Growth and
reproduction
MAPK
signaling pathway
Long-chain fatty acid
PEPCK
G6PC
Inhibition of gluconeogenesis
PPARα
RXR
Retinoic acid
DNA
Peroxisome proliferation,
Fattyacid metabolism
Mitochondrion
ADIPO
ADIPOR
AMPKK
+p
AMPK
+p
ACC2
Malonyl-CoA
CPT-1
beta-Oxidation
GLUT1/4
Glucose uptake

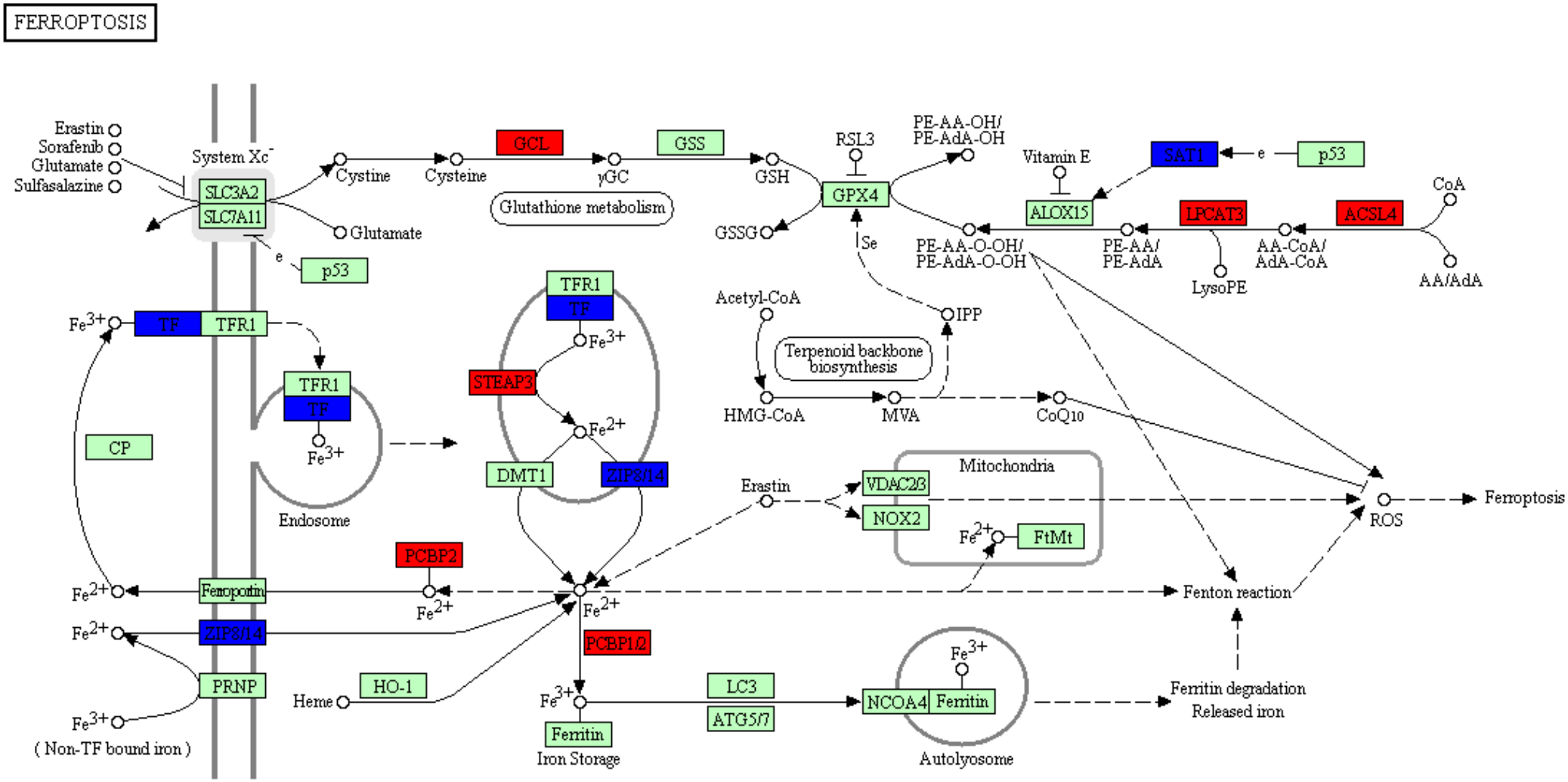
AMPHETAMINE ADDICTION



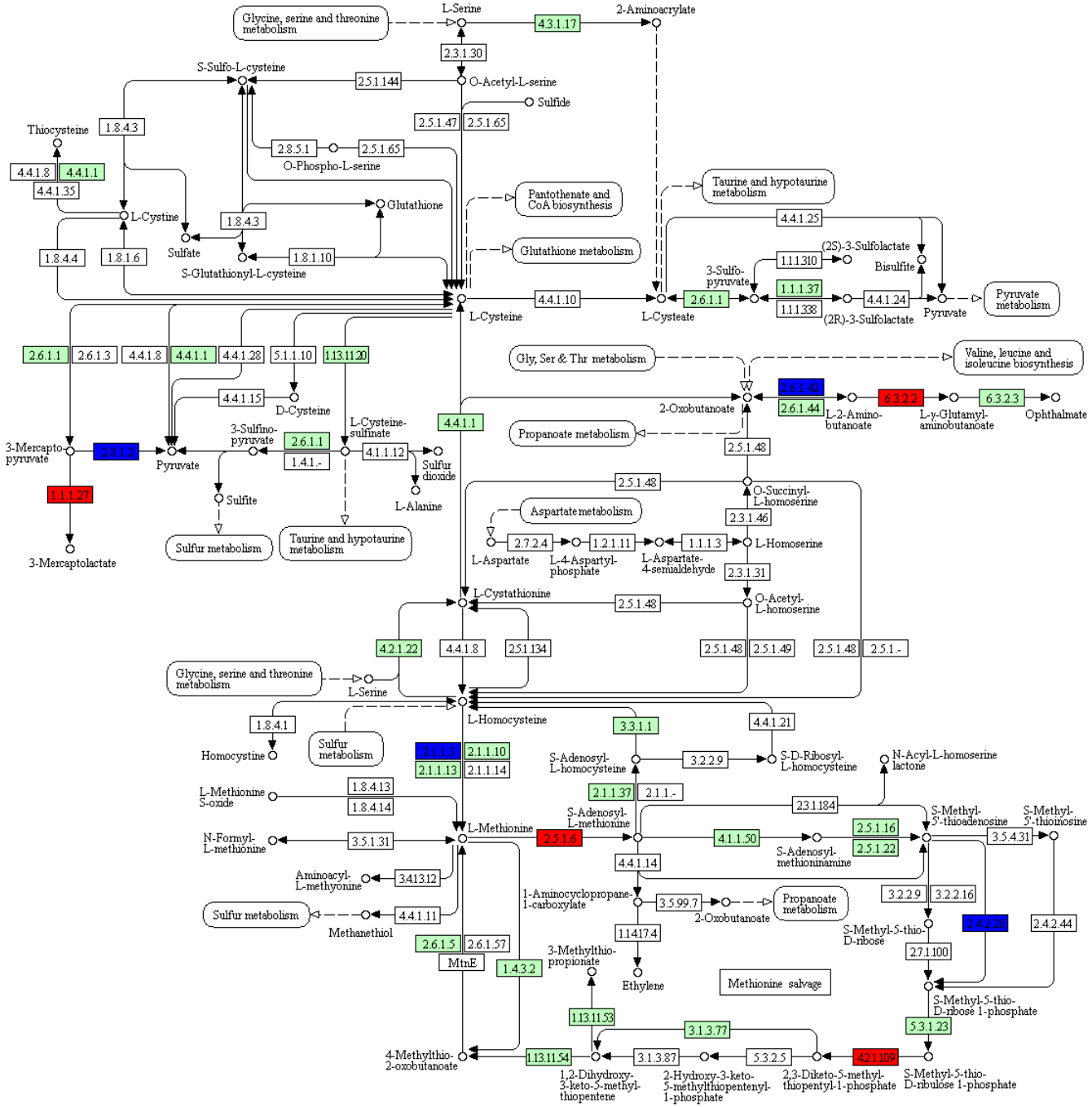

GASTRIC ACID SECRETION
Chief cell (Pepsinogen)
/ Mucous neck cell
/ Enterochromaffin cell (ANP)
/ Enterochromaffin-like cell (Histamine)
/ D cell (Somatostatin)
/ Surface mucous cell
Tight junction
Interstitium
Basolateral membrane
Gastric parietal cell
Vagal nerve
Ach
M3
Gq
PLC
DAG
PKC
F-actin
β-actin
Apical membrane
Tight junction
IP3
+p
Ezrin
Gastrin-cell
GAST
CCK2R
Ca2+
IP3R
CaM
Calcium signaling pathway
Endoplasmic reticulum (ER)
Gastric gland lumen
CaMKII
MLCK
Histamine
ECL-cell
Histamine
H2R
Gs
AC
cAMP
PKA
+p
Ezrin
H/K
H+, K+-ATPase
Translocation
E2/Q1
Jx
H/K
H+, K+-ATPase
Acid (HCl)
Tubulovesicle
D cell
SST
SSTR2
Gi
CFTR
Cl-
Protein digestion and absorption
KCN
K+
Na/K
Na+
NHE1/4
H+
H2O
CA
H2CO3
CO2
Cl-
AE
HCO3-
CO2
Tight junction
Chief cell (Pepsinogen)
/ Mucous neck cell
/ Enterochromaffin cell (ANP)
/ Enterochromaffin-like cell (Histamine)
/ D cell (Somatostatin)
/ Surface mucous cell

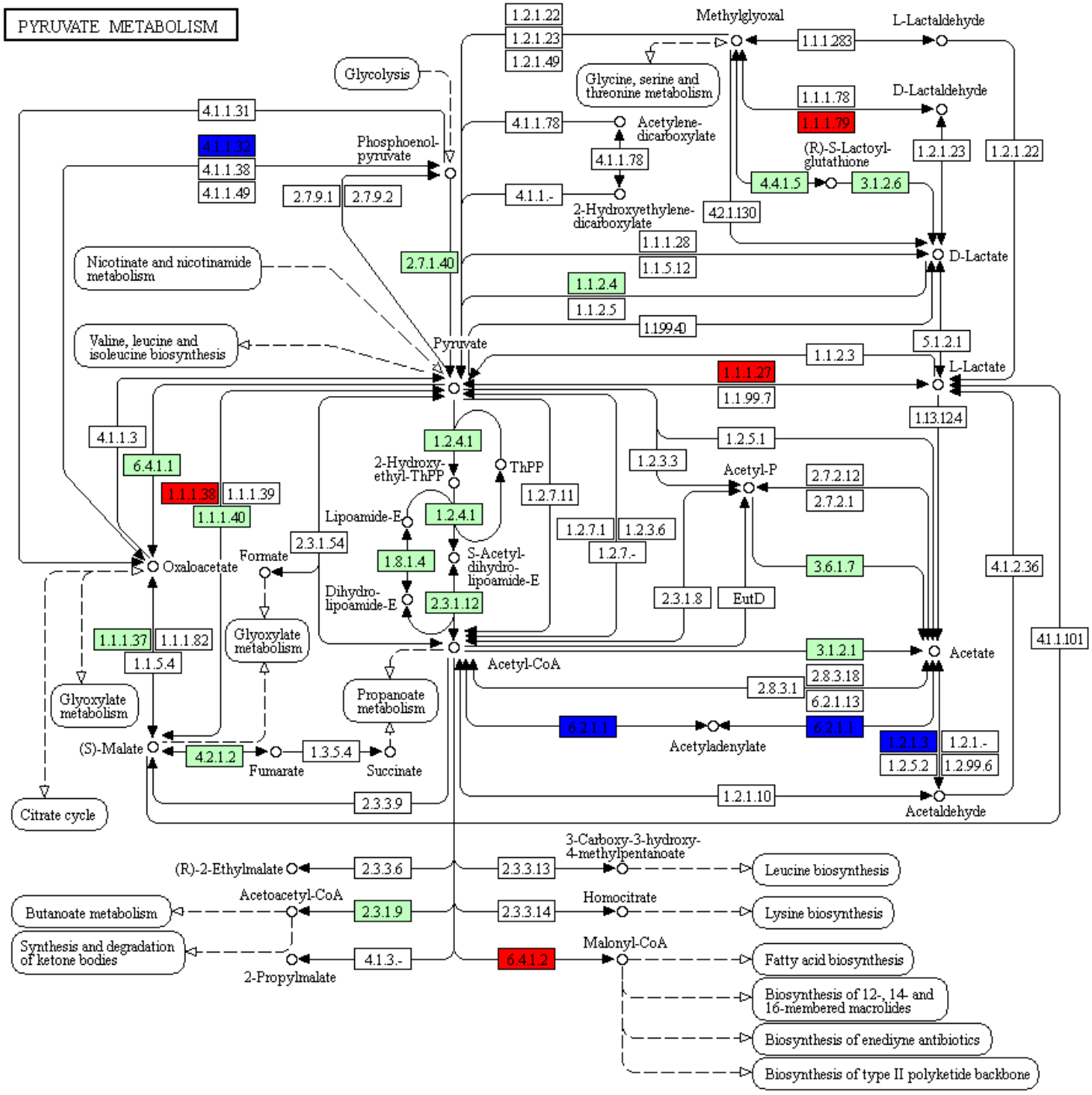

GLYCINE, SERINE AND THREONINE METABOLISM
Glyoxylate metabolism
2-Phospho-D-glycerate
5.4.2.11
5.4.2.12
Glycolysis / Gluconeogenesis
2.7.1.165
1.1.1.29
1.1.1.81
Hydroxy-pyruvate
Glycerate
3.1.3.38
2.7.1.31
3P-D-Glycerate
1.1.1.95
3P-Hydroxy-pyruvate
2.6.1.52
Phosphoserine
3.1.3.3
Methane metabolism
Sphingolipid metabolism
5.1.1.18
5.1.1.10
D-Serine
D-Lombricine
2.7.3.5
N-Phospho-D-lombricine
4.3.1.18
Citrate cycle
Pyruvate metabolism
2.6.1.45
2.6.1.51
4.3.1.17
4.3.1.19
Pyruvate
Serine
L-Tryptophane
4.2.1.20
Tryptophane metabolism
2.7.8.8
4.2.1.22
Cystathionine
4.2.1.22
Sulfur metabolism
Glycerophospholipid metabolism
O-Phosphatidyl-L-serine
4.4.1.1
2.6.1.45
Cyanoamino acid metabolism
2.1.2.1
5,10-Methylene-THF
Choline
Cysteine and methionine metabolism
L-Cysteine
1.4.2.1
1.4.3.3
Glyoxylate
Glyoxylate metabolism
NH3
Dihydro-lipoylprotein
1.14.15.7
1.1.3.17
1.1.99.1
GbsB
Arginine and proline metabolism
Creatine
2.1.1.2
2.1.4.1
Guanidinoacetate
3.5.3.3
2.6.1.4
2.6.1.44
CO2
2.1.2.10
H-protein
GCSH
THF
1.8.1.4
2.1.1.157
Dimethylglycine
1.2.1.8
1.1.3.17
Betaine aldehyde
2.1.1.5
Betaine
1.5.8.4
Sarcosine
1.5.3.1
1.5.8.3
Glycine
1.4.4.2
S-Amino-methyldihydro-lipoylprotein
2.1.1.20
2.1.1.161
2.1.1.156
Lipoylprotein
2.3.1.37
5-Aminolevulinate
Porphyrine biosynthesis
Purine metabolism
4.1.2.48
4.1.2.49
L-Allothreonine
1.1.1.381
Aminoacetone
2.3.1.29
1.1.1.75
Aminopropan-2-ol
L-2-Amino-acetoacetate
4.1.2.48
4.1.2.5
1.4.3.4
1.4.3.21
1.1.1.103
Methylglyoxal
Valine, leucine and isoleucine biosynthesis
Propanoate metabolism
4.3.1.19
2-Oxobutanoate
Threonine
4.2.3.1
O-Phospho-L-homoserine
2.7.1.39
Propane-1,3-diamine
Arginine and proline metabolism
Cysteine and methionine metabolism
Homoserine
4.1.1.86
Ectoine biosynthesis
1.1.1.3
L-2,4-Diamino-butanoate
Alanine, aspartate and glutamate metabolism
L-Aspartate
2.7.2.4
L-4-Aspartyl-phosphate
1.2.1.11
L-Aspartate 4-semialdehyde
2.6.1.76
2.3.1.178
Nγ-Acetyl-L-2,4-diaminobutyrate
4.2.1.108
L-Ectoine
1.14.11.55
5-Hydroxyectoine
DoeC
DoeD
3.5.1.125
3.5.4.44
Nα-Acetyl-L-2,4-diaminobutyrate
Lysine biosynthesis

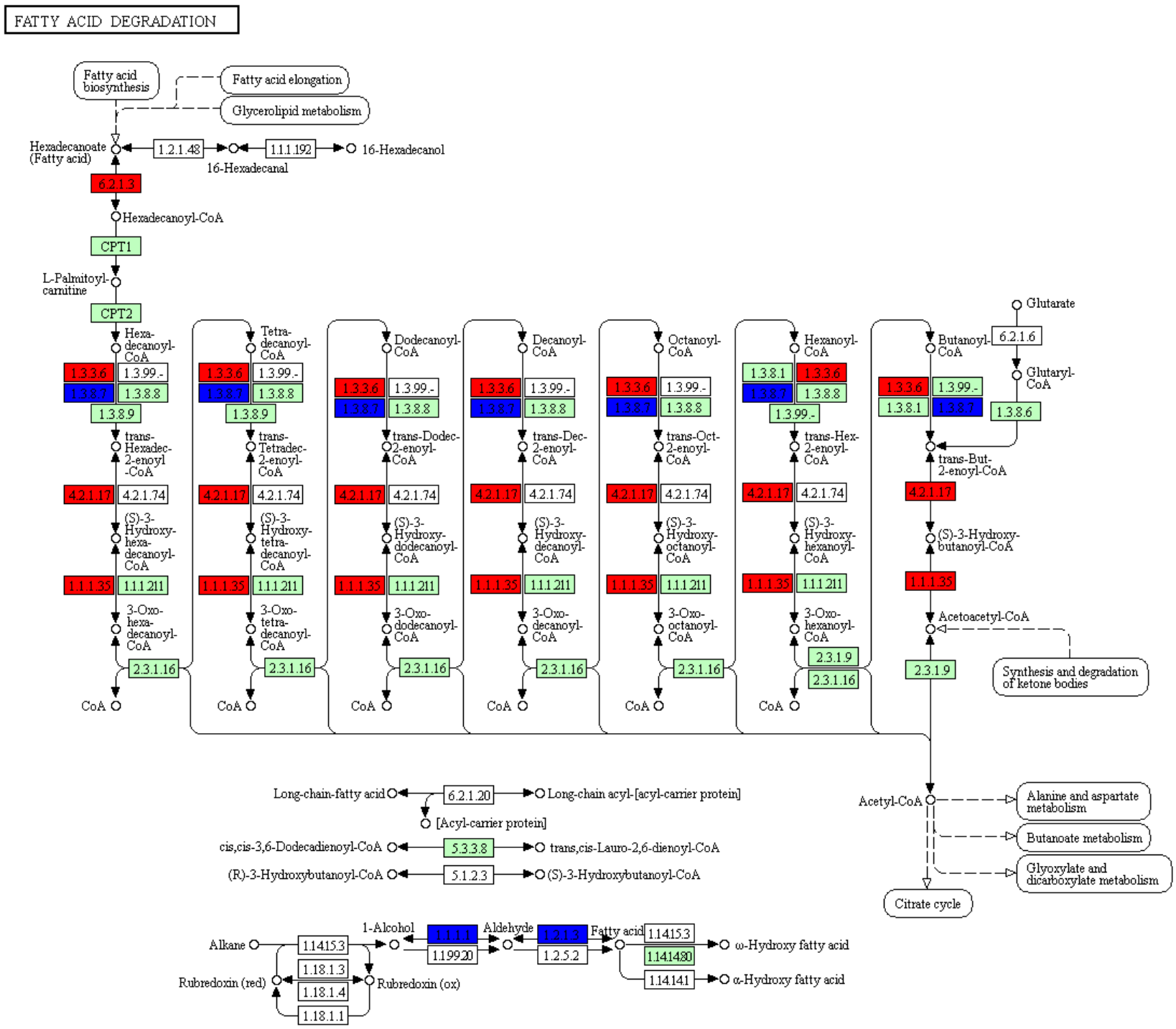

ARGININE AND PROLINE METABOLISM
N2-Succinyl-L-ornithine
2.6.1.81
N2-Succinyl-L-glutamate 5-semialdehyde
1.2.1.71
N2-Succinyl-glutamate
3.5.1.96
Glutamate
Alanine, aspartate and glutamate metabolism
3.5.3.23
Guanidino-acetate-P
2.7.3.1
3.5.2.10
2.7.2.11
N2-Succinyl-L-arginine
Guanidino-acetate
2.1.1.2
Creatine
2.7.3.2
Creatine-P
spontaneous
Creatinine
1.2.1.88
1.2.1.88
Creatine pathway
3.5.3.3
Urea
3.5.4.21
L-Glutamyl-P
D-Nopaline
D-Octopine
2.1.4.1
Peptide
4-Oxoproline
Arginine biosynthesis
23.1.109
Sarcosine
3.5.1.59
N-Carbamoyl-sarcosine
3.5.2.14
N-Methyl-hydantoin
1.2.1.41
PRODH
3.4.11.5
1.1.1.104
1.5.5.2
1.5.1.2
1.5.1.2
1-Pyrroline-3-hydroxy-5-carboxylate
1.5.1.19
1.5.1.11
Arginine
3.5.3.1
Ornithine
2.6.1.13
L-Glutamate 5-semialdehyde
1-Pyrroline-5-carboxylate
1.5.5.2
Proline
1.14.11.2
4-Hydroxy-proline
1.5.5.3
1.2.1.88
L-erythro-4-Hydroxy-glutamate
2.3.1.271
N-Acetylglutamate semialdehyde
Arginine biosynthesis
4.3.1.12
5.1.1.8
4-Hydroxyglutamate semialdehyde
1.2.1.88
1.14.13.39
1.14.14.47
4.1.1.19
N-Carbamoyl-putrescine
3.5.3.12
3.5.1.53
4.1.1.17
2.7.3.3
Nω-Hydroxy-arginine
1.5.1.1
1.5.1.49
2-Oxo-5-aminovalerate
5.1.1.4
cis-4-Hydroxy-D-proline
2.6.1.1
2.6.1.21
2.6.1.23
1.14.13.39
1.14.14.47
3.5.3.11
Agmatine
4.2.1.77
1.4.3.3
1.5.99.13
Linatine
trans-3-Hydroxy-proline
1-Pyrroline-2-carboxylate
D-Proline
1.4.3.3
1.5.99.-
2-Oxo-4-hydroxy-5-aminovalerate
L-Arginine-P
Nitric oxide
p-Coumaroyl-CoA
2.3.1.64
p-Coumaroyl-agmatine
ACT
p-Coumaroyl-ptrescine
4.2.1.171
cys-3-Hydroxy-proline
1.4.1.12
1.21.4.1
(R)-4-Hydroxy-2-oxoglutarate
2.6.1.84
1.4.3.25
Lysine degradation
5-Amino-pentanoate
Pyrrole-2-carboxylate
4.1.3.16
2-Oxoarginine
Feruloyl-CoA
2.3.1.64
Feruloyl-agmatine
ACT
Feruloyl-ptrescine
Tropane, piperidine and pyridine alkaloid biosynthesis
Cysteine and methionine metabolism
1-Pyrroline-4-hydroxy-2-carboxylate
3.5.4.22
Pyruvate
Glyoxylate
4.1.1.75
1.13.12.1
Putrescine
2,5-Dioxopentanoate
Citrate cycle
PuuA
2.3.1.57
3.5.1.62
Glycine metabolism
L-Aspartate-4-semialdehyde
S-Adenosyl-L-methionine
Ascorbate and aldarate metabolism
Glycine, serine and threonine metabolism
4-Guanidino-butanal
4-Guanidino-butanamide
γ-L-Glutamyl-putrescine
N-Acetyl-putrescine
1,3-Diamino-propane
4.1.1.50
PuuB
1.4.3.4
1.4.3.10
2.6.1.29
1.5.1.43
1.5.1.43
1.5.3.17
Pentose and glucuronate interconversions
Glyoxylate and dicarboxylate metabolism
γ-Glutamyl-γ-amino-butyraldehyde
N4-Acetyl-aminobutanal
1.4.3.22
2.6.1.82
2.6.1.113
Carboxy-norspermidine
Carboxy-spermidine
S-Adenosyl-metioninamine
PuuC
1.2.1.3
4.1.1.96
4.1.1.96
1.2.1.54
3.5.1.4
γ-Glutamyl-γ-amino-butyrate
N4-Acetyl-aminobutanoate
2.5.1.16
Norspermidine
4-Amino-butanal
1.5.3.14
1.5.99.6
2.5.1.16
2.5.1.22
Spermine
β-Alanine metabolism
PuuD
3.5.1.63
1.2.1.3
Spermidine
1.5.3.16
1.5.3.17
Polyamine Pathway
Glutathione metabolism
1.2.1.19
1.2.1.-
ADH pathway
ADC pathway
4-Amino-butanoate
6.3.2.11
3.4.13.18
3.4.13.20
L-Homocarnosine
3.5.3.7
4-Guanidino-butanoate
2.1.4.1
Alanine, aspartate and glutamate metabolism
Butanoate metabolism


FERROPTOSIS
Erastin
Sorafenib
Glutamate
Sulfasalazine
System Xc-
SLC3A2
SLC7A11
Cystine
Cysteine
GCL
γGC
GSS
GSH
GSSG
Glutathione metabolism
Glutamate
e
p53
RSL3
GPX4
PE-AA-OH/
PE-AdA-OH
Vitamin E
ALOX15
SAT1
e
p53
LPCAT3
ACSL4
CoA
PE-AA-O-OH/
PE-AdA-O-OH
PE-AA/
PE-AdA
AA-CoA/
AdA-CoA
LysoPE
AA/AdA
Se
Fe3+
TF
TFR1
TFR1
TF
Fe3+
STEAP3
Fe2+
DMT1
ZIP8/14
Endosome
CP
Acetyl-CoA
IPP
Terpenoid backbone
biosynthesis
HMG-CoA
MVA
CoQ10
Mitochondria
Erastin
VDAC2/3
NOX2
Fe2+
FtMt
ROS
Ferroptosis
PCBP2
Fe2+
Ferroportin
Fe2+
ZIP8/14
Fe2+
PRNP
Fe3+
(Non-TF bound iron)
Heme
HO-1
Fe2+
PCBP1/2
Fe3+
Ferritin
Iron Storage
LC3
ATG5/7
Fe3+
NCOA4
Ferritin
Autolyosome
Fenton reaction
Ferritin degradation
Released iron

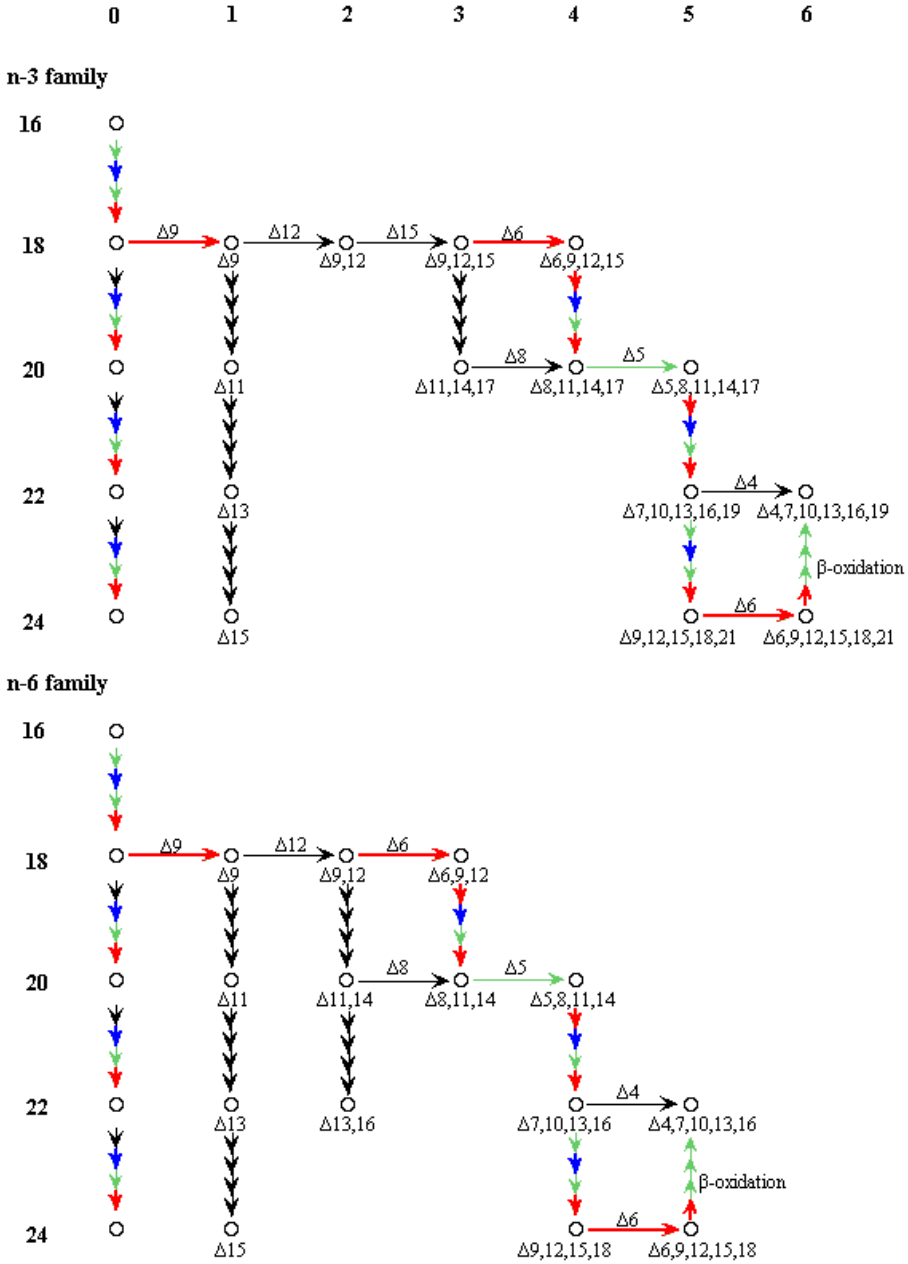
CYSTEINE AND METHIONINE METABOLISM

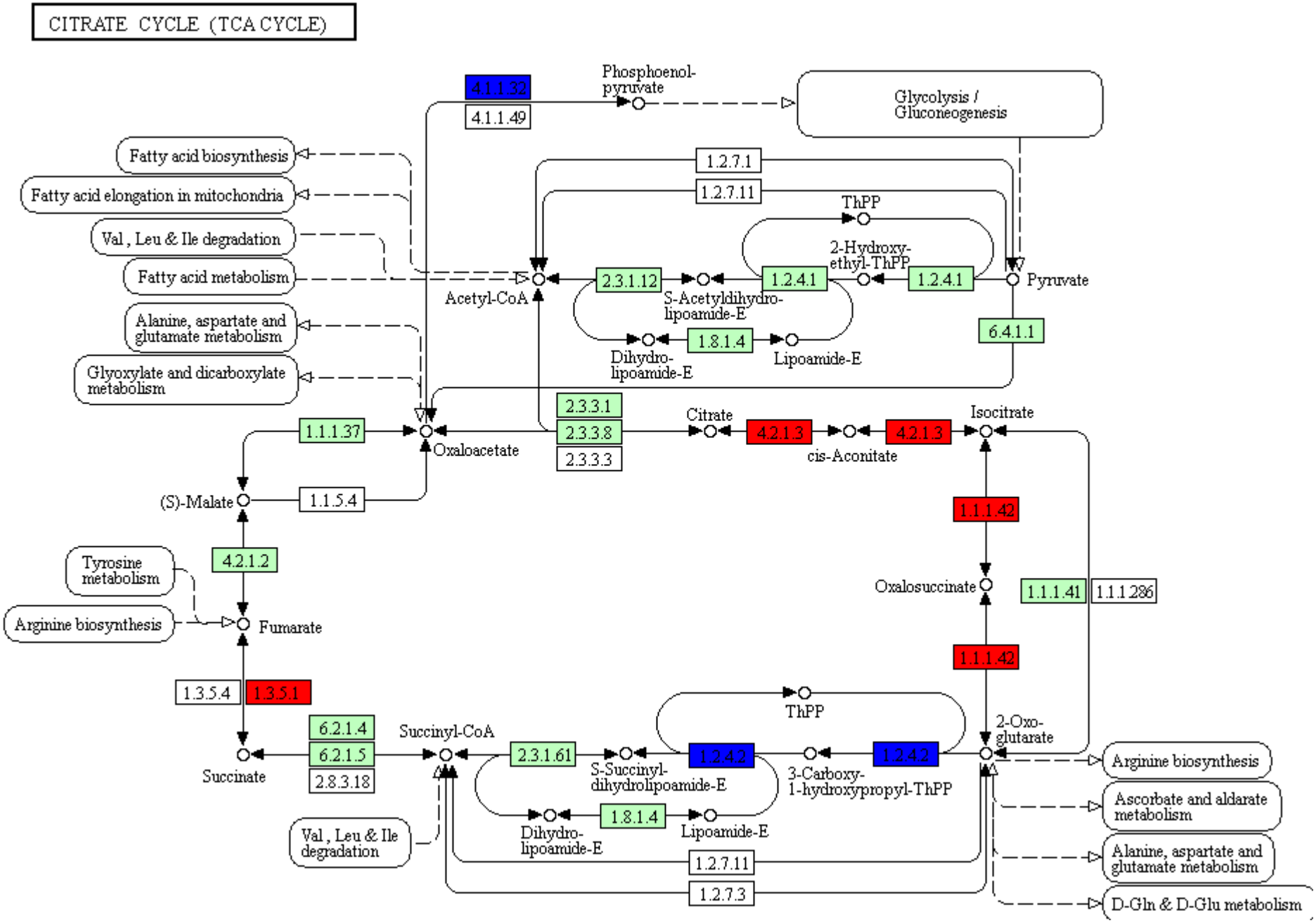


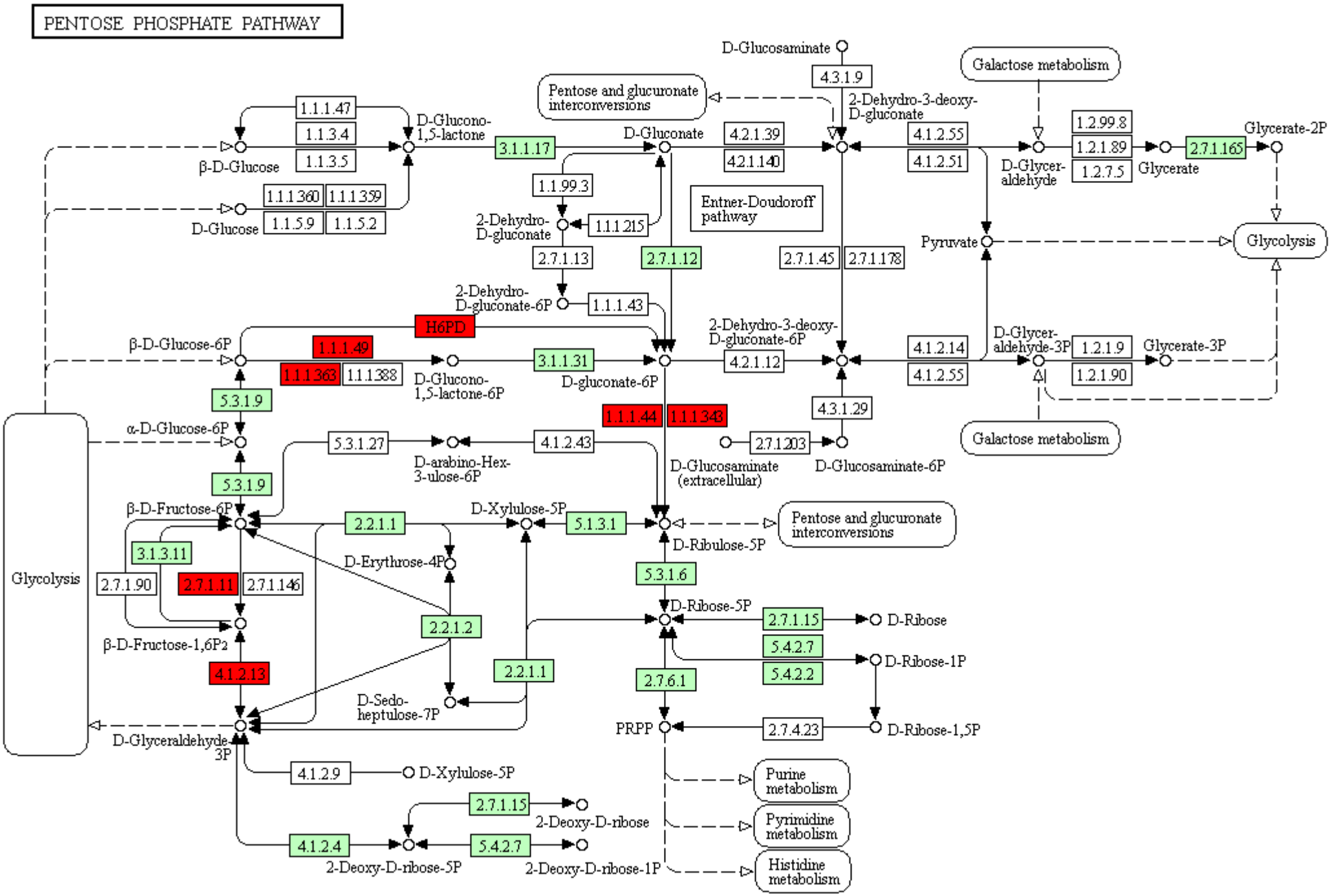

PYRUVATE METABOLISM
Glycolysis
Phosphoenol-pyruvate
Nicotinate and nicotinamide metabolism
Valine, leucine and isoleucine biosynthesis
Pyruvate
Oxaloacetate
Formate
Lipoamide-E
2-Hydroxy-ethyl-ThPP
ThPP
S-Acetyl-dihydro-lipoamide-E
Dihydro-lipoamide-E
Acetyl-CoA
Acetyl-P
EutD
Acetate
Glyoxylate metabolism
Propanoate metabolism
(S)-Malate
Fumarate
Succinate
Citrate cycle
Methylglyoxal
L-Lactaldehyde
Glycine, serine and threonine metabolism
D-Lactaldehyde
Acetylene-dicarboxylate
(R)-S-Lactoyl-glutathione
2-Hydroxyethylene-dicarboxylate
D-Lactate
L-Lactate
Acetaldehyde
Acetyladenylate
(R)-2-Ethylmalate
3-Carboxy-3-hydroxy-4-methylpentanoate
Leucine biosynthesis
Butanoate metabolism
Acetoacetyl-CoA
Homocitrate
Lysine biosynthesis
Synthesis and degradation of ketone bodies
2-Propylmalate
Malonyl-CoA
Fatty acid biosynthesis
Biosynthesis of 12-, 14- and 16-membered macrolides
Biosynthesis of enediyne antibiotics
Biosynthesis of type II polyketide backbone

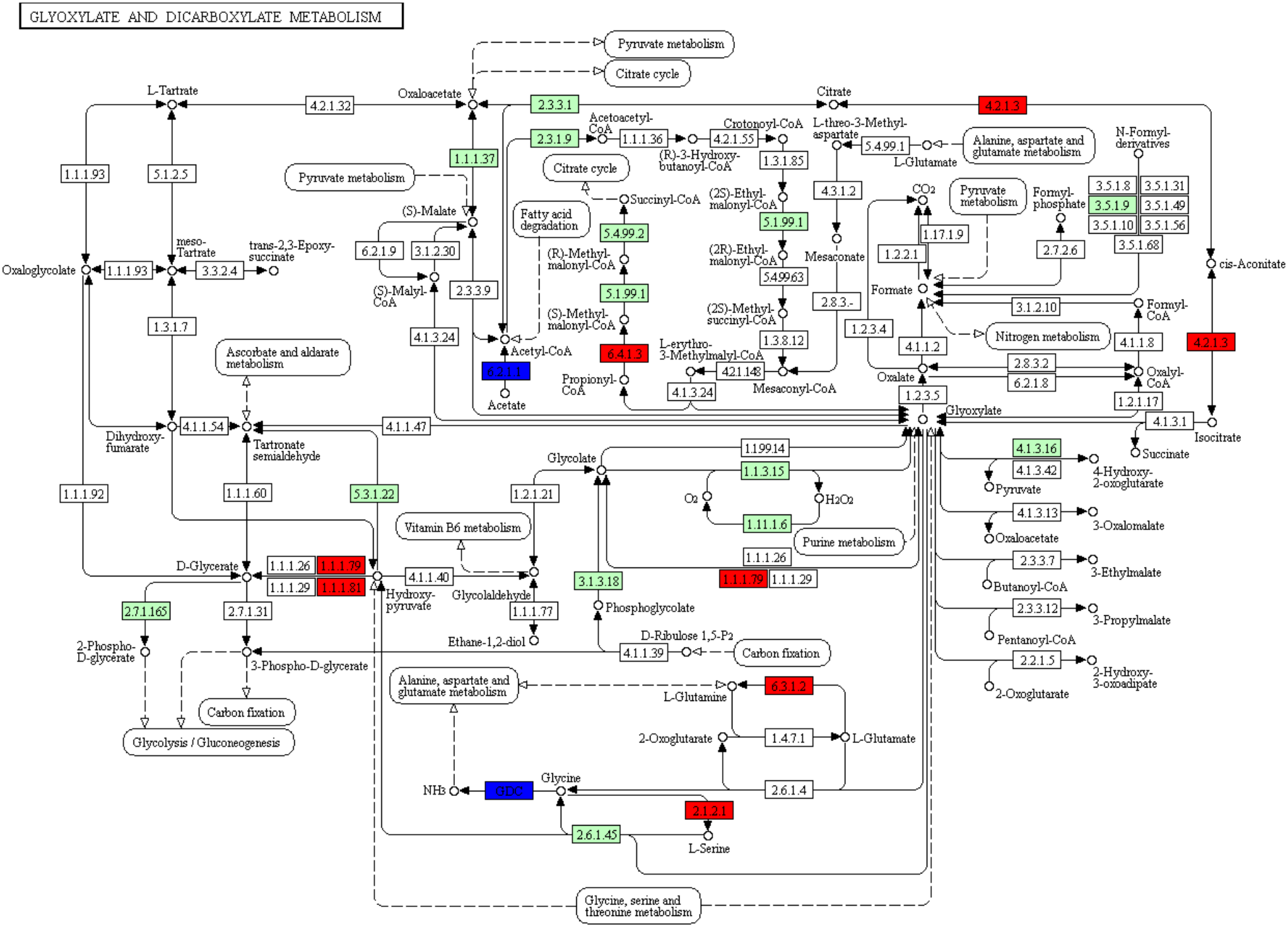

FATTY ACID DEGRADATION
Fatty acid biosynthesis
Fatty acid elongation
Glycerolipid metabolism
Hexadecanoate (Fatty acid)
1.2.1.48
16-Hexadecanal
1.1.1.192
16-Hexadecanol
6.2.1.3
Hexadecanoyl-CoA
CPT1
L-Palmitoyl-carnitine
CPT2
Hexa-decanoyl-CoA
Tetra-decanoyl-CoA
Dodecanoyl-CoA
Decanoyl-CoA
Octanoyl-CoA
Hexanoyl-CoA
Butanoyl-CoA
Glutarate
6.2.1.6
Glutaryl-CoA
1.3.8.6
1.3.3.6
1.3.99.-
1.3.8.7
1.3.8.8
1.3.8.9
1.3.8.1
1.3.99.-
trans-Hexadec-2-enoyl-CoA
trans-Tetradec-2-enoyl-CoA
trans-Dodec-2-enoyl-CoA
trans-Dec-2-enoyl-CoA
trans-Oct-2-enoyl-CoA
trans-Hex-2-enoyl-CoA
trans-But-2-enoyl-CoA
4.2.1.17
4.2.1.74
(S)-3-Hydroxy-hexa-decanoyl-CoA
(S)-3-Hydroxy-tetra-decanoyl-CoA
(S)-3-Hydroxy-dodecanoyl-CoA
(S)-3-Hydroxy-decanoyl-CoA
(S)-3-Hydroxy-octanoyl-CoA
(S)-3-Hydroxy-hexanoyl-CoA
(S)-3-Hydroxy-butanoyl-CoA
1.1.1.35
1.1.1.211
3-Oxo-hexa-decanoyl-CoA
3-Oxo-tetra-decanoyl-CoA
3-Oxo-dodecanoyl-CoA
3-Oxo-decanoyl-CoA
3-Oxo-octanoyl-CoA
3-Oxo-hexanoyl-CoA
Acetoacetyl-CoA
2.3.1.16
2.3.1.9
CoA
Synthesis and degradation of ketone bodies
Long-chain-fatty acid
6.2.1.20
Long-chain acyl-[acyl-carrier protein]
[Acyl-carrier protein]
cis,cis-3,6-Dodecadienoyl-CoA
5.3.3.8
trans,cis-Lauro-2,6-dienoyl-CoA
(R)-3-Hydroxybutanoyl-CoA
5.1.2.3
(S)-3-Hydroxybutanoyl-CoA
Acetyl-CoA
Alanine and aspartate metabolism
Butanoate metabolism
Glyoxylate and dicarboxylate metabolism
Citrate cycle
Alkane
1.14.15.3
1-Alcohol
1.1.1.1
1.1.99.20
Aldehyde
1.2.1.3
1.2.5.2
Fatty acid
1.14.15.3
1.14.14.80
1.14.14.1
ω-Hydroxy fatty acid
α-Hydroxy fatty acid
Rubredoxin (red)
1.18.1.3
1.18.1.4
1.18.1.1
Rubredoxin (ox)

BIOSYNTHESIS OF UNSATURATED FATTY ACIDS

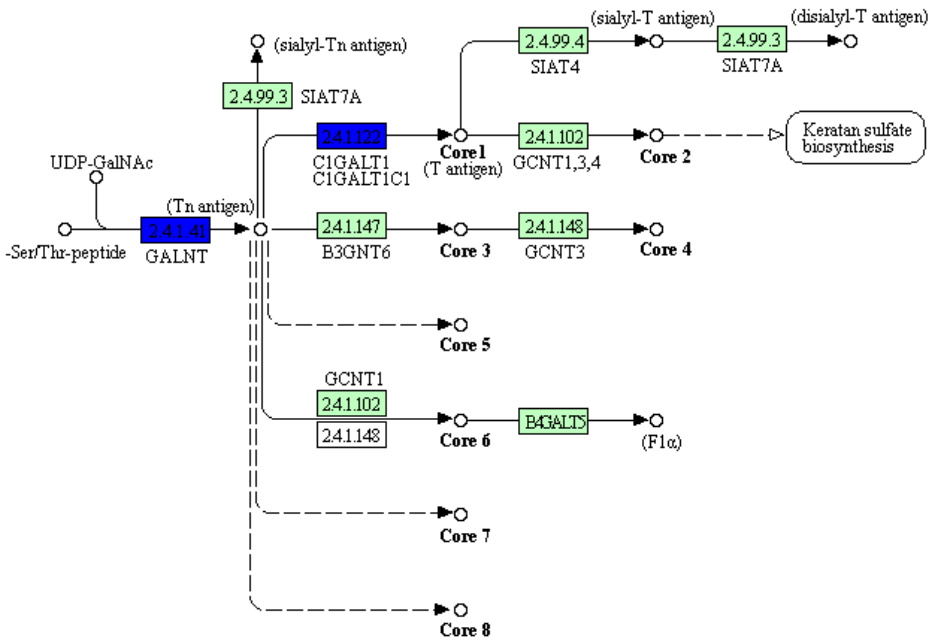



CITRATE CYCLE (TCA CYCLE)
4.1.1.32
4.1.1.49
Phosphoenol-pyruvate
Glycolysis / Gluconeogenesis
Fatty acid biosynthesis
Fatty acid elongation in mitochondria
Val , Leu & Ile degradation
Fatty acid metabolism
Alanine, aspartate and glutamate metabolism
Glyoxylate and dicarboxylate metabolism
1.2.7.1
1.2.7.11
ThPP
2-Hydroxy-ethyl-ThPP
2.3.1.12
1.2.4.1
1.2.4.1
Pyruvate
Acetyl-CoA
S-Acetyldihydro-lipoamide-E
1.8.1.4
Dihydro-lipoamide-E
Lipoamide-E
6.4.1.1
2.3.1.1
2.3.3.8
2.3.3.3
Citrate
4.2.1.3
4.2.1.3
cis-Aconitate
Isocitrate
1.1.1.37
Oxaloacetate
(S)-Malate
1.1.5.4
1.1.1.42
Tyrosine metabolism
4.2.1.2
Arginine biosynthesis
Fumarate
Oxalosuccinate
1.1.1.41
1.1.1.286
1.1.1.42
1.3.5.4
1.3.5.1
ThPP
2-Oxo-glutarate
6.2.1.4
6.2.1.5
2.8.3.18
Succinyl-CoA
2.3.1.61
1.2.4.2
1.2.4.2
Succinate
S-Succinyl-dihydrolipoamide-E
3-Carboxy-1-hydroxypropyl-ThPP
Arginine biosynthesis
Ascorbate and aldarate metabolism
Alanine, aspartate and glutamate metabolism
D-Gln & D-Glu metabolism
Val , Leu & Ile degradation
1.8.1.4
Dihydro-lipoamide-E
Lipoamide-E
1.2.7.11
1.2.7.3

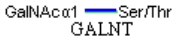

PENTOSE PHOSPHATE PATHWAY
D-Glucosaminate
4.3.1.9
Galactose metabolism
Pentose and glucuronate interconversions
2-Dehydro-3-deoxy-D-gluconate
1.1.1.47
1.1.3.4
1.1.3.5
D-Glucono-1,5-lactone
3.1.1.17
D-Gluconate
4.2.1.39
4.2.1.140
4.1.2.55
4.1.2.51
1.2.99.8
1.2.1.89
1.2.7.5
Glycerate-2P
2.7.1.165
Glycerate
β-D-Glucose
1.1.1.360
1.1.1.359
1.1.5.9
1.1.5.2
D-Glucose
1.1.99.3
2-Dehydro-D-gluconate
1.1.1.215
Entner-Doudoroff pathway
D-Glycer-aldehyde
Pyruvate
Glycolysis
2.7.1.13
2.7.1.12
2.7.1.45
2.7.1.178
2-Dehydro-D-gluconate-6P
1.1.1.43
H6PD
2-Dehydro-3-deoxy-D-gluconate-6P
β-D-Glucose-6P
1.1.1.49
1.1.1.363
1.1.1.388
D-Glucono-1,5-lactone-6P
3.1.1.31
D-gluconate-6P
4.2.1.12
4.1.2.14
4.1.2.55
D-Glycer-aldehyde-3P
1.2.1.9
1.2.1.90
Glycerate-3P
5.3.1.9
1.1.1.44
1.1.1.343
4.3.1.29
α-D-Glucose-6P
5.3.1.27
4.1.2.43
2.7.1.203
D-arabino-Hex-3-ulose-6P
D-Glucosaminate (extracellular)
D-Glucosaminate-6P
Galactose metabolism
5.3.1.9
β-D-Fructose-6P
D-Xylulose-5P
2.2.1.1
5.1.3.1
Pentose and glucuronate interconversions
D-Ribulose-5P
3.1.3.11
D-Erythrose-4P
5.3.1.6
Glycolysis
2.7.1.90
2.7.1.11
2.7.1.146
D-Ribose-5P
2.7.1.15
D-Ribose
2.2.1.2
5.4.2.7
5.4.2.2
D-Ribose-1P
β-D-Fructose-1,6P2
4.1.2.13
2.2.1.1
2.7.6.1
D-Sedo-heptulose-7P
PRPP
2.7.4.23
D-Ribose-1,5P
D-Glyceraldehyde-3P
4.1.2.9
D-Xylulose-5P
Purine metabolism
2.7.1.15
2-Deoxy-D-ribose
Pyrimidine metabolism
4.1.2.4
5.4.2.7
2-Deoxy-D-ribose-5P
2-Deoxy-D-ribose-1P
Histidine metabolism


GLYOXYLATE AND DICARBOXYLATE METABOLISM
Pyruvate metabolism
Citrate cycle
L-Tartrate
4.2.1.32
Oxaloacetate
2.3.3.1
Citrate
4.2.1.3
Acetoacetyl-CoA
2.3.1.9
1.1.1.36
Crotonoyl-CoA
4.2.1.55
L-threo-3-Methyl-aspartate
5.4.99.1
L-Glutamate
Alanine, aspartate and glutamate metabolism
N-Formyl-derivatives
(R)-3-Hydroxy-butanoyl-CoA
1.3.1.85
1.1.1.93
5.1.2.5
1.1.1.37
Pyruvate metabolism
Citrate cycle
Succinyl-CoA
(2S)-Ethyl-malonyl-CoA
5.1.99.1
4.3.1.2
CO2
Pyruvate metabolism
Formyl-phosphate
3.5.1.8
3.5.1.31
3.5.1.9
3.5.1.49
3.5.1.10
3.5.1.56
3.5.1.68
(S)-Malate
Fatty acid degradation
5.4.99.2
(R)-Methyl-malonyl-CoA
(2R)-Ethyl-malonyl-CoA
5.4.99.63
Mesaconate
1.17.1.9
1.2.2.1
2.7.2.6
meso-Tartrate
trans-2,3-Epoxy-succinate
Oxaloglycolate
1.1.1.93
3.3.2.4
6.2.1.9
3.1.2.30
(S)-Malyl-CoA
2.3.3.9
(S)-Methyl-malonyl-CoA
5.1.99.1
(2S)-Methyl-succinyl-CoA
2.8.3.-
Formate
3.1.2.10
Formyl-CoA
cis-Aconitate
1.3.1.7
4.1.3.24
Acetyl-CoA
6.4.1.3
L-erythro-3-Methylmalyl-CoA
4.2.1.148
1.3.8.12
1.2.3.4
Nitrogen metabolism
4.1.1.2
4.1.1.8
4.2.1.3
Ascorbate and aldarate metabolism
6.2.1.1
Propionyl-CoA
Mesaconyl-CoA
Oxalate
2.8.3.2
6.2.1.8
Oxalyl-CoA
Acetate
4.1.3.24
1.2.3.5
1.2.1.17
Glyoxylate
4.1.3.1
Isocitrate
Succinate
4.1.1.54
4.1.1.47
Dihydroxy-fumarate
Tartronate semialdehyde
Glycolate
1.1.99.14
4.1.3.16
4.1.3.42
4-Hydroxy-2-oxoglutarate
Pyruvate
1.1.3.15
1.1.92
1.1.1.60
5.3.1.22
1.2.1.21
O2
H2O2
4.1.3.13
3-Oxalomalate
Oxaloacetate
Vitamin B6 metabolism
1.11.1.6
Purine metabolism
1.1.1.26
2.3.3.7
3-Ethylmalate
Butanoyl-CoA
D-Glycerate
1.1.1.26
1.1.1.79
1.1.1.29
1.1.1.81
4.1.1.40
Hydroxy-pyruvate
Glycolaldehyde
1.1.1.77
3.1.3.18
1.1.1.79
1.1.1.29
2.3.3.12
3-Propylmalate
Pentanoyl-CoA
2.7.1.165
2.7.1.31
Phosphoglycolate
Ethane-1,2-diol
D-Ribulose 1,5-P2
4.1.1.39
Carbon fixation
2-Phospho-D-glycerate
3-Phospho-D-glycerate
2.2.1.5
2-Hydroxy-3-oxoadipate
2-Oxoglutarate
Alanine, aspartate and glutamate metabolism
6.3.1.2
L-Glutamine
Carbon fixation
Glycolysis / Gluconeogenesis
2-Oxoglutarate
1.4.7.1
L-Glutamate
NH3
GDC
Glycine
2.6.1.4
2.1.2.1
2.6.1.45
L-Serine
Glycine, serine and threonine metabolism

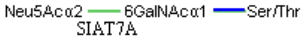
MUCIN TYPE O-GLYCAN BIOSYNTHESIS



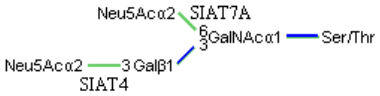
Tn antigen



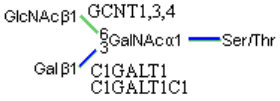
Sialyl-Tn antigen



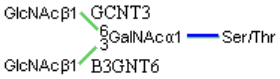
Disialyl-T antigen



Core 1, 2

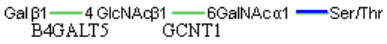


Core 3, 4



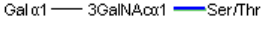
Core 5

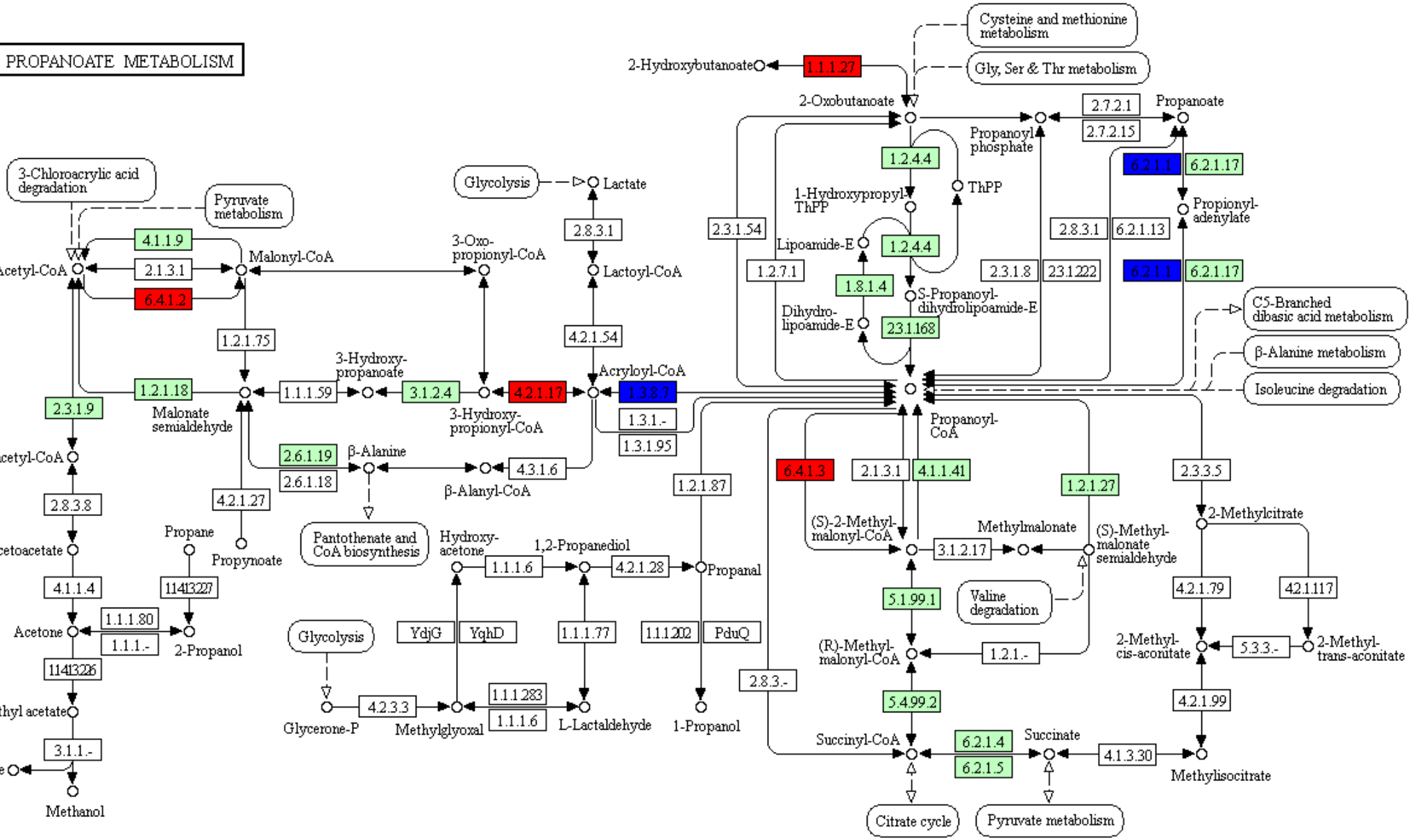
Core 6 & F1α



Core 7

Core 8




PROPANOATE METABOLISM
Cysteine and methionine metabolism
Gly, Ser & Thr metabolism
2-Hydroxybutanoate
1.1.1.27
2-Oxobutanoate
2.7.2.1
2.7.2.15
Propanoate
Propanoyl phosphate
1.2.4.4
ThPP
1-Hydroxypropyl-ThPP
6.2.1.1
6.2.1.17
Propionyl-adenylate
2.3.1.54
Lipoamide-E
1.2.4.4
2.8.3.1
6.2.1.13
1.2.7.1
1.8.1.4
2.3.1.8
23.1222
6.2.1.1
6.2.1.17
S-Propanoyl-dihydrolipoamide-E
Dihydro-lipoamide-E
23.1.168
C5-Branched dibasic acid metabolism
β-Alanine metabolism
Isoleucine degradation
3-Chloroacrylic acid degradation
Pyruvate metabolism
Glycolysis
Lactate
2.8.3.1
Lactoyl-Acetyl-CoA
4.1.1.9
2.1.3.1
6.4.1.2
Malonyl-CoA
3-Oxo-propionyl-CoA
4.2.1.54
Acryloyl-CoA
1.2.1.75
3-Hydroxy-propanoate
1.2.1.18
1.1.1.59
3.1.2.4
4.2.1.17
1.3.8.7
1.3.1.-
1.3.1.95
2.3.1.9
Malonate semialdehyde
3-Hydroxy-propionyl-CoA
Propanoyl-CoA
2.6.1.19
2.6.1.18
β-Alanine
4.3.1.6
β-Alanyl-CoA
6.4.1.3
2.1.3.1
4.1.1.41
1.2.1.27
2.3.3.5
1.2.1.87
2.8.3.8
4.2.1.27
Propane
Propynoate
Pantothenate and CoA biosynthesis
(S)-2-Methyl-malonyl-CoA
Methylmalonate
3.1.2.17
(S)-Methyl-malonate semialdehyde
2-Methylcitrate
Hydroxy-acetone
1,2-Propanediol
1.1.1.6
4.2.1.28
Propanal
4.1.1.4
11413227
5.1.99.1
Valine degradation
4.2.1.79
42.1.117
1.1.1.80
1.1.1.-
Acetone
2-Propanol
Glycolysis
YdjG
YqhD
1.1.1.77
1.1.1202
PduQ
(R)-Methyl-malonyl-CoA
1.2.1.-
2-Methyl-cis-aconitate
5.3.3.-
2-Methyl-trans-aconitate
11413226
2.8.3.-
5.4.99.2
4.2.1.99
3.1.1.-
Glycerone-P
4.2.3.3
1.1.1.283
1.1.1.6
Methylglyoxal
L-Lactaldehyde
1-Propanol
Succinyl-CoA
6.2.1.4
6.2.1.5
Succinate
4.1.3.30
Methylisocitrate
Methanol
Citrate cycle
Pyruvate metabolism

PROXIMAL TUBULE BICARBONATE RECLAMATION