
rtezomib, 4 Hou
tezomib, 24 Ho
tezomib, 72 Ho
Autophagy
Chaperone Mediated Autophagy
Late endosomal microautophagy
Macroautophagy
Selective autophagy
Mitophagy
PINK1−PRKN Mediated Mitophagy
Aggrephagy
Pexophagy
Cell Cycle
Cell Cycle Checkpoints
G2/M Checkpoints
G1/S DNA Damage Checkpoints
p53−Dependent G1/S DNA damage checkpoint
p53−Dependent G1 DNA Damage Response
p53−Independent G1/S DNA damage checkpoint
p53−Independent DNA Damage Response
Cell Cycle, Mitotic
Mitotic G2−G2/M phases
G2/M Transition
Regulation of PLK1 Activity at G2/M Transition
Centrosome maturation
The role of GTSE1 in G2/M progression after G2 checkpoint
FBXL7 down−regulates AURKA during mitotic entry and in early mitosis
AURKA Activation by TPX2
Regulation of mitotic cell cycle
APC/C−mediated degradation of cell cycle proteins
Autodegradation of Cdh1 by Cdh1:APC/C
APC/C:Cdh1 mediated degradation of Cdc20 and other APC/C:Cdh1 targeted proteins
Regulation of APC/C activators between G1/S and early anaphase
Activation of APC/C and APC/C:Cdc20 mediated degradation of mitotic proteins
Mitotic G1 phase and G1/S transition
G1/S Transition
E2F mediated regulation of DNA replication
Cyclin E associated events during G1/S transition
G1/S−Specific Transcription
M Phase
Mitotic Metaphase and Anaphase
Mitotic Anaphase
Mitotic Prometaphase
Recruitment of NuMA to mitotic centrosomes
S Phase
Cyclin A:Cdk2−associated events at S phase entry
SCF(Skp2)−mediated degradation of p27/p21
Ubiquitin−dependent degradation of Cyclin D
Cell−Cell communication
Cell junction organization
Cell−extracellular matrix interactions
Cellular responses to stimuli
Cellular responses to stress
Cellular response to hypoxia
Oxygen−dependent proline hydroxylation of Hypoxia−inducible Factor Alpha
Cellular Senescence
Oncogene Induced Senescence
HSP90 chaperone cycle for steroid hormone receptors (SHR) in the presence of lig
Cellular response to heat stress
Regulation of HSF1−mediated heat shock response
HSF1 activation
HSF1−dependent transactivation
Attenuation phase
Unfolded Protein Response (UPR)
IRE1alpha activates chaperones
XBP1(S) activates chaperone genes
Heme signaling
Cellular response to starvation
Response of EIF2AK4 (GCN2) to amino acid deficiency
Amino acids regulate mTORC1
Cellular response to chemical stress
Detoxification of Reactive Oxygen Species
Cytoprotection by HMOX1
KEAP1−NFE2L2 pathway
Regulation of BACH1 activity
Nuclear events mediated by NFE2L2
Chromatin organization
Chromatin modifying enzymes
RMTs methylate histone arginines
DNA Repair
DNA Damage Bypass
Translesion synthesis by Y family DNA polymerases bypasses lesions on DNA templa
Translesion synthesis by REV1
Translesion Synthesis by POLH
Translesion synthesis by POLK
Translesion synthesis by POLI
Recognition of DNA damage by PCNA−containing replication complex
DNA Double−Strand Break Repair
Homology Directed Repair
HDR through Homologous Recombination (HRR) or Single Strand Annealing (SSA)
HDR through Homologous Recombination (HRR)
Processing of DNA double−strand break ends
DNA Double Strand Break Response
Recruitment and ATM−mediated phosphorylation of repair and signaling proteins at
Fanconi Anemia Pathway
Nucleotide Excision Repair
Global Genome Nucleotide Excision Repair (GG−NER)
DNA Damage Recognition in GG−NER
Formation of Incision Complex in GG−NER
Gap−filling DNA repair synthesis and ligation in GG−NER
DNA Replication
DNA Replication Pre−Initiation
Assembly of the pre−replicative complex
Synthesis of DNA
Switching of origins to a post−replicative state
Orc1 removal from chromatin
CDK−mediated phosphorylation and removal of Cdc6
Developmental Biology
Gastrulation
Formation of paraxial mesoderm
Somitogenesis
Nervous system development
Axon guidance
EPH−Ephrin signaling
EPH−ephrin mediated repulsion of cells
Semaphorin interactions
Sema3A PAK dependent Axon repulsion
Signaling by ROBO receptors
Regulation of expression of SLITs and ROBOs
Disease
Diseases of DNA repair
Diseases of DNA Double−Strand Break Repair
Defective homologous recombination repair (HRR) due to BRCA1 loss of function
Defective homologous recombination repair (HRR) due to PALB2 loss of function
Defective HDR through Homologous Recombination Repair (HRR) due to PALB2 loss of
Defective HDR through Homologous Recombination Repair (HRR) due to PALB2 loss of
Diseases of metabolism
Defects in vitamin and cofactor metabolism
Defects in cobalamin (B12) metabolism
Diseases of carbohydrate metabolism
Diseases of signal transduction by growth factor receptors and second messengers
Signaling by ERBB2 in Cancer
Constitutive Signaling by Overexpressed ERBB2
Signaling by ERBB2 KD Mutants
Signaling by ERBB2 ECD mutants
Signaling by ERBB2 TMD/JMD mutants
Signaling by EGFR in Cancer
Signaling by EGFRvIII in Cancer
Constitutive Signaling by EGFRvIII
Signaling by Ligand−Responsive EGFR Variants in Cancer
Constitutive Signaling by Ligand−Responsive EGFR Cancer Variants
Hh mutants abrogate ligand secretion
Hh mutants are degraded by ERAD
Signaling by KIT in disease
Signaling by phosphorylated juxtamembrane, extracellular and kinase domain KIT m
Signaling by PDGFR in disease
Signaling by PDGFRA transmembrane, juxtamembrane and kinase domain mutants
Signaling by PDGFRA extracellular domain mutants
Signaling by ALK in cancer
Signaling by ALK fusions and activated point mutants
Disorders of transmembrane transporters
ABC transporter disorders
Defective CFTR causes cystic fibrosis
Infectious disease
Bacterial Infection Pathways
Uptake and actions of bacterial toxins
Listeria monocytogenes entry into host cells
InlB−mediated entry of Listeria monocytogenes into host cell
Parasitic Infection Pathways
Leishmania infection
Leishmania parasite growth and survival
Viral Infection Pathways
HIV Infection
HIV Life Cycle
Host Interactions of HIV factors
Influenza Infection
Influenza Viral RNA Transcription and Replication
SARS−CoV Infections
SARS−CoV−1 Infection
Potential therapeutics for SARS
SARS−CoV−2 Infection
Respiratory Syncytial Virus Infection Pathway
Respiratory syncytial virus (RSV) genome replication, transcription and translat
Extracellular matrix organization
Integrin cell surface interactions
Non−integrin membrane−ECM interactions
Gene expression (Transcription)
Epigenetic regulation of gene expression
Positive epigenetic regulation of rRNA expression
ERCC6 (CSB) and EHMT2 (G9a) positively regulate rRNA expression
Gene Silencing by RNA
PIWI−interacting RNA (piRNA) biogenesis
RNA Polymerase II Transcription
Generic Transcription Pathway
Transcriptional Regulation by TP53
TP53 Regulates Metabolic Genes
Regulation of TP53 Activity
TP53 Regulates Transcription of Cell Cycle Genes
Transcriptional regulation by RUNX3
Regulation of RUNX3 expression and activity
Transcriptional regulation by RUNX2
Regulation of RUNX2 expression and activity
Transcriptional regulation by RUNX1
Regulation of RUNX1 Expression and Activity
RUNX1 regulates transcription of genes involved in differentiation of HSCs
FOXO−mediated transcription
Hemostasis
Cell surface interactions at the vascular wall
Factors involved in megakaryocyte development and platelet production
Kinesins
Platelet activation, signaling and aggregation
GPVI−mediated activation cascade
Response to elevated platelet cytosolic Ca2+
Platelet degranulation
Immune System
Adaptive Immune System
Immunoregulatory interactions between a Lymphoid and a non−Lymphoid cell
TCR signaling
Downstream TCR signaling
Phosphorylation of CD3 and TCR zeta chains
Translocation of ZAP−70 to Immunological synapse
Generation of second messenger molecules
Costimulation by the CD28 family
PD−1 signaling
Class I MHC mediated antigen processing & presentation
Antigen processing−Cross presentation
ER−Phagosome pathway
Cross−presentation of soluble exogenous antigens (endosomes)
Antigen processing: Ubiquitination & Proteasome degradation
Antigen Presentation: Folding, assembly and peptide loading of class I MHC
Signaling by the B Cell Receptor (BCR)
Downstream signaling events of B Cell Receptor (BCR)
Activation of NF−kappaB in B cells
Antigen activates B Cell Receptor (BCR) leading to generation of second messenge
Cytokine Signaling in Immune system
Signaling by Interleukins
Interleukin−7 signaling
Interleukin−1 family signaling
Interleukin−1 signaling
Interleukin−12 family signaling
Interleukin−35 Signalling
Interleukin−2 family signaling
Interleukin−2 signaling
Interleukin−3, Interleukin−5 and GM−CSF signaling
Interleukin−4 and Interleukin−13 signaling
TNFR2 non−canonical NF−kB pathway
TNFs bind their physiological receptors
NIK−−>noncanonical NF−kB signaling
TNF receptor superfamily (TNFSF) members mediating non−canonical NF−kB pathway
Interferon Signaling
Antiviral mechanism by IFN−stimulated genes
PKR−mediated signaling
Interferon gamma signaling
Interferon alpha/beta signaling
Regulation of IFNA/IFNB signaling
Growth hormone receptor signaling
Innate Immune System
Toll−like Receptor Cascades
Toll Like Receptor 3 (TLR3) Cascade
TICAM1, RIP1−mediated IKK complex recruitment
TAK1−dependent IKK and NF−kappa−B activation
TICAM1−dependent activation of IRF3/IRF7
TICAM1,TRAF6−dependent induction of TAK1 complex
DDX58/IFIH1−mediated induction of interferon−alpha/beta
TRAF3−dependent IRF activation pathway
Negative regulators of DDX58/IFIH1 signaling
Cytosolic sensors of pathogen−associated DNA
Fcgamma receptor (FCGR) dependent phagocytosis
Regulation of actin dynamics for phagocytic cup formation
Role of phospholipids in phagocytosis
DAP12 interactions
DAP12 signaling
Fc epsilon receptor (FCERI) signaling
FCERI mediated MAPK activation
FCERI mediated Ca+2 mobilization
FCERI mediated NF−kB activation
C−type lectin receptors (CLRs)
CLEC7A (Dectin−1) signaling
Dectin−1 mediated noncanonical NF−kB signaling
Neutrophil degranulation
Alpha−protein kinase 1 signaling pathway
Metabolism
Biological oxidations
Phase I − Functionalization of compounds
Metabolism of amino acids and derivatives
Selenoamino acid metabolism
Selenocysteine synthesis
Metabolism of polyamines
Regulation of ornithine decarboxylase (ODC)
Metabolism of carbohydrates
Glycogen metabolism
Glycogen synthesis
Metabolism of lipids
Phospholipid metabolism
PI Metabolism
Synthesis of PIPs at the plasma membrane
Metabolism of nucleotides
Nucleotide salvage
Metabolism of vitamins and cofactors
Metabolism of water−soluble vitamins and cofactors
Cobalamin (Cbl, vitamin B12) transport and metabolism
Metabolism of cofactors
The citric acid (TCA) cycle and respiratory electron transport
Respiratory electron transport, ATP synthesis by chemiosmotic coupling, and heat
Formation of ATP by chemiosmotic coupling
Respiratory electron transport
Complex I biogenesis
Metabolism of RNA
Mitochondrial RNA degradation
FASTK family proteins regulate processing and stability of mitochondrial RNAs
Nonsense−Mediated Decay (NMD)
Nonsense Mediated Decay (NMD) independent of the Exon Junction Complex (EJC)
Nonsense Mediated Decay (NMD) enhanced by the Exon Junction Complex (EJC)
Regulation of mRNA stability by proteins that bind AU−rich elements
AUF1 (hnRNP D0) binds and destabilizes mRNA
rRNA processing
rRNA processing in the mitochondrion
rRNA processing in the nucleus and cytosol
rRNA modification in the nucleus and cytosol
Major pathway of rRNA processing in the nucleolus and cytosol
tRNA processing
tRNA processing in the mitochondrion
Metabolism of proteins
Mitochondrial protein degradation
Post−translational protein modification
SUMOylation
SUMO E3 ligases SUMOylate target proteins
SUMOylation of intracellular receptors
Asparagine N−linked glycosylation
N−glycan trimming in the ER and Calnexin/Calreticulin cycle
Calnexin/calreticulin cycle
Deubiquitination
UCH proteinases
Ub−specific processing proteases
Ovarian tumor domain proteases
Metalloprotease DUBs
Protein ubiquitination
Synthesis of active ubiquitin: roles of E1 and E2 enzymes
E3 ubiquitin ligases ubiquitinate target proteins
Protein methylation
Neddylation
Carboxyterminal post−translational modifications of tubulin
Protein folding
Post−chaperonin tubulin folding pathway
Chaperonin−mediated protein folding
Cooperation of Prefoldin and TriC/CCT in actin and tubulin folding
Prefoldin mediated transfer of substrate to CCT/TriC
Formation of tubulin folding intermediates by CCT/TriC
Translation
Eukaryotic Translation Elongation
Peptide chain elongation
SRP−dependent cotranslational protein targeting to membrane
Eukaryotic Translation Initiation
L13a−mediated translational silencing of Ceruloplasmin expression
Cap−dependent Translation Initiation
Activation of the mRNA upon binding of the cap−binding complex and eIFs, and sub
Formation of a pool of free 40S subunits
Formation of the ternary complex, and subsequently, the 43S complex
Ribosomal scanning and start codon recognition
GTP hydrolysis and joining of the 60S ribosomal subunit
Eukaryotic Translation Termination
Neuronal System
Transmission across Chemical Synapses
Neurotransmitter receptors and postsynaptic signal transmission
Activation of kainate receptors upon glutamate binding
Organelle biogenesis and maintenance
Cilium Assembly
Anchoring of the basal body to the plasma membrane
Intraflagellar transport
Mitochondrial biogenesis
Cristae formation
Programmed Cell Death
Apoptosis
Regulation of Apoptosis
Regulation of activated PAK−2p34 by proteasome mediated degradation
Regulated Necrosis
RIPK1−mediated regulated necrosis
Regulation of necroptotic cell death
Protein localization
Peroxisomal protein import
Signal Transduction
Death Receptor Signaling
p75 NTR receptor−mediated signalling
p75NTR signals via NF−kB
p75NTR recruits signalling complexes
NF−kB is activated and signals survival
Cell death signalling via NRAGE, NRIF and NADE
NRAGE signals death through JNK
NRIF signals cell death from the nucleus
TNF signaling
Regulation of TNFR1 signaling
Intracellular signaling by second messengers
PIP3 activates AKT signaling
PTEN Regulation
Regulation of PTEN stability and activity
MAPK family signaling cascades
MAPK1/MAPK3 signaling
RAF/MAP kinase cascade
Regulation of RAS by GAPs
MAPK6/MAPK4 signaling
Signaling by GPCR
GPCR downstream signalling
G alpha (q) signalling events
G alpha (12/13) signalling events
G alpha (s) signalling events
GPER1 signaling
G alpha (i) signalling events
GPCR ligand binding
Class A/1 (Rhodopsin−like receptors)
Class B/2 (Secretin family receptors)
Signaling by Hedgehog
Hedgehog ligand biogenesis
Hedgehog 'off' state
Degradation of GLI1 by the proteasome
Degradation of GLI2 by the proteasome
GLI3 is processed to GLI3R by the proteasome
Hedgehog 'on' state
Signaling by NOTCH
Signaling by NOTCH1
Activated NOTCH1 Transmits Signal to the Nucleus
Signaling by NOTCH2
NOTCH2 Activation and Transmission of Signal to the Nucleus
Signaling by NOTCH3
NOTCH3 Activation and Transmission of Signal to the Nucleus
NOTCH3 Intracellular Domain Regulates Transcription
Signaling by NOTCH4
Negative regulation of NOTCH4 signaling
Signaling by Non−Receptor Tyrosine Kinases
Signaling by PTK6
PTK6 Regulates RHO GTPases, RAS GTPase and MAP kinases
Signaling by Nuclear Receptors
ESR−mediated signaling
Extra−nuclear estrogen signaling
Estrogen−dependent nuclear events downstream of ESR−membrane signaling
Signaling by Receptor Tyrosine Kinases
Signaling by ERBB2
Downregulation of ERBB2 signaling
Signaling by SCF−KIT
Regulation of KIT signaling
Signaling by EGFR
EGFR downregulation
Signaling by FGFR
Signaling by FGFR1
Negative regulation of FGFR1 signaling
Signaling by FGFR2
Negative regulation of FGFR2 signaling
Signaling by FGFR3
Negative regulation of FGFR3 signaling
Signaling by FGFR4
Negative regulation of FGFR4 signaling
Signaling by VEGF
VEGFA−VEGFR2 Pathway
VEGFR2 mediated vascular permeability
Signaling by MET
Negative regulation of MET activity
Signaling by Rho GTPases, Miro GTPases and RHOBTB3
Signaling by Rho GTPases
RHO GTPase cycle
CDC42 GTPase cycle
RAC1 GTPase cycle
RHOH GTPase cycle
RHOBTB GTPase Cycle
Signaling by TGFB family members
Signaling by TGF−beta Receptor Complex
Transcriptional activity of SMAD2/SMAD3:SMAD4 heterotrimer
Downregulation of SMAD2/3:SMAD4 transcriptional activity
SMAD2/SMAD3:SMAD4 heterotrimer regulates transcription
Signaling by WNT
Degradation of beta−catenin by the destruction complex
TCF dependent signaling in response to WNT
Formation of the beta−catenin:TCF transactivating complex
Deactivation of the beta−catenin transactivating complex
Degradation of AXIN
Degradation of DVL
Beta−catenin independent WNT signaling
Ca2+ pathway
PCP/CE pathway
Asymmetric localization of PCP proteins
Transport of small molecules
ABC−family proteins mediated transport
Iron uptake and transport
Plasma lipoprotein assembly, remodeling, and clearance
Plasma lipoprotein clearance
VLDLR internalisation and degradation
SLC−mediated transmembrane transport
Transport of bile salts and organic acids, metal ions and amine compounds
Vesicle−mediated transport
Membrane Trafficking
Gap junction trafficking and regulation
Gap junction trafficking
ER to Golgi Anterograde Transport
COPI−mediated anterograde transport
trans−Golgi Network Vesicle Budding
Golgi Associated Vesicle Biogenesis
Intra−Golgi and retrograde Golgi−to−ER traffic
Golgi−to−ER retrograde transport
COPI−dependent Golgi−to−ER retrograde traffic
COPI−independent Golgi−to−ER retrograde traffic
Clathrin−mediated endocytosis
Cargo recognition for clathrin−mediated endocytosis
Rab regulation of trafficking
Endosomal Sorting Complex Required For Transport (ESCRT)
CD4 Naive
CD4 CM
CD4 EM
CD4 Treg
CD8 Naive
CD8 Memory
CD4 Naive
CD4 CM
CD4 EM
CD4 Treg
CD8 Naive
CD8 Memory
CD4 Naive
CD4 CM
CD4 EM
CD4 Treg
CD8 Naive
CD8 Memory