
Subject Index

- 20S particle, 149

- A-box, 153
- acetyltransferase, 186
- adenomatous polyposis coli (Apc), 103
- aging, 258, 263
- Ago, 157
- allantois, 343, 356
- anaphase, 154, 160, 168
- anaphase promoting complex/cyclosome (APC/C), 93, 95, 101, 149, 150, 153–156, 158, 160, 163, 164
- aneuploidy, 93, 99, 103
- APC^{Cdc20}, 153–155, 160, 168
- APC^{Cdh1}, 153, 155, 162
- Apc11, 152
- Apc2, 152
- apoptosis, 183, 187, 195–199, 205, 206, 271, 282, 285, 292, 312, 329, 332, 335–337, 345, 354, 355, 357–359
- Archipelago, 157
- ARE, 333, 334, 336
- ARS, 32, 35
- Ase1, 150
- ATPase, 39–41, 166
- atresia, 345
- Aurora A, 150, 153
- Aurora B, 94, 99, 101, 103, 104
- Aurora C, 101, 103
- Aurora kinase, 98, 103

- bHLH, 209, 210
- bipolar attachment, 153
- bipolar chromosome attachment, 168
- Bmi-1, 262
- Bub1, 94, 95, 98, 101, 103, 104
- Bub3, 94, 95, 97, 98, 104, 155
- BubR1, 94, 95, 97, 98, 103, 104, 155, 164

- c-myc, 33, 158, 160
- cancer, 159, 183, 211, 227, 259, 271, 272, 276, 294, 295, 297–299, 310, 311
- carcinogen, 229
- Cdc16, 152
- Cdc18, 158
- Cdc2, 230, 271–273, 275–280, 282, 293, 300, 301, 303–305, 307, 309, 312, 313
- Cdc20, 93, 95, 97, 98, 102, 104, 150, 152–155, 158, 160, 163, 164, 166, 168
- Cdc23, 152
- Cdc25, 164, 230, 354
- Cdc25A, 150, 158, 164, 165
- Cdc26, 152
- Cdc27, 152
- Cdc34, 151
- Cdc4, 151, 157–160, 162, 163, 168
 - haploinsufficiency of, 160
- Cdc42, 162
- Cdc45, 43–47
- Cdc5/Plk, 150
- Cdc53, 151, 152, 156
- Cdc6, 36–42, 49, 150, 158
- Cdc7, 44, 45
- Cdh1, 152, 153, 158, 160, 162
- Cdk, 5, 149, 154, 162, 353–356
 - activation of, 5
 - Cdk2 knockouts, 14
 - Cdk3 knockouts, 14
 - Cdk4 knockouts, 12
 - Cdk6 knockouts, 12
 - S phase, 159, 168
- Cdk inhibitor (CKI), 159, 161, 162, 166, 168, 230
- Cdk1, 149, 159, 161, 164, 165
- Cdk2, 153, 159, 164, 165, 184, 185, 187, 188, 193, 196, 208, 232, 259–261, 271–273, 275–286, 289, 293, 294, 296, 298–301, 303–305, 307, 309–313, 334, 335, 353, 354

- Cdk3, 278, 279
 Cdk4, 184, 185, 188, 193, 196, 208, 232,
 259–262, 273, 276, 278, 281, 284, 285,
 287, 289, 290, 294, 297, 298, 300, 301,
 307–313
 Cdk6, 184, 232, 260–262, 273, 276, 278, 284,
 285, 287, 290, 308–310
CDKN1A, 166
 Cdk5, 161, 271, 272, 275, 276, 278, 279, 281,
 285, 300, 302, 303, 305, 307, 309–311
 Cdt1, 36, 37, 40–42, 49, 161, 165
 cell cycle, 77, 78, 150, 183–186, 188, 190,
 192, 193, 195, 196, 198, 199, 205–207,
 210, 271–282, 284–286, 289, 291–296,
 298–301, 304, 307–313, 343, 345,
 353–358, 360
 – Cdc25A, 77, 78
 – Cdc7, 78
 – Cdk2, 78
 – p21, 77
 – p53, 77
 – yeast, 151
 cell cycle engine, 4, 8
 – MPF, 4
 cell cycle theory, 1, 19
 – cell division, 2
 – development of, 4
 – future of, 23
 cell division, 230, 272, 273, 275, 282, 293,
 294, 305, 307, 311, 353
 cell division cycle (*cdc*), 147
 – mutants, 151, 152
 cell growth, 6
 – conservation of mass, 6
 – mass increase, 22
 cell lines, 271, 272, 276–278, 286, 311
 cell migration, 271, 301, 303
 CENP-E, 94, 97, 98, 101, 102
 centrosomes, 293, 301
 checkpoint, 4, 42, 46, 47, 93–95, 98, 99,
 101–104, 163, 166, 238
 – critical size threshold, 6
 – DNA damage, 4, 164, 165
 – replication, 164
 – size threshold, 21
 – spindle assembly, 163
 – spindle integrity, 163
 – stress response, 20
 checkpoint signaling, 97, 101
 chimaeras, 236
 Chk1, 164, 165
 Chk2, 164, 165
 chromatin, 166
 chromatin modulation, 66, 81
 – 19S proteasome, 81
 – histone H2AX, 81
 – INO80, 81
 – methylation, 81
 – NuA4, 81
 – ubiquitination, 81
 chromosomal instability, 103
 chromosomal passenger complexes, 101
 chromosome, 154, 343, 353, 355, 358, 359
 chromosome instability, 159
 Cin8/Kip1, 150
 CKIs, 272
 Cks1, 161
 Clb2, 150
 Clb5, 150
 Cln1, 158, 159, 162
 Cln2, 158, 159
 cohesin, 154
 – sister chromatid, 154
 cohesion
 – sister chromatid, 156
 crisis, 262, 263
 Ctd1, 158, 162
 Cul1, 152, 156
 Cullin, 151
 cyclin, 5, 149, 154, 155, 161, 271–273,
 275–277, 279, 280, 283, 284, 288–290,
 294, 301, 304, 306–310, 312, 313, 353,
 355
 – cyclin D knockouts, 13
 – cyclin E knockouts, 15
 – expression of, 8
 – G1, 159
 – mitotic, 149, 152, 155
 cyclin A, 150, 153, 155, 160, 240, 273,
 275–277, 279, 280, 289, 291, 296, 305,
 307, 309
 cyclin A-Cdk2, 162
 cyclin B, 150, 152, 153, 155
 cyclin B-Cdk1, 154, 160
 cyclin D, 184, 185, 188, 208, 210
 – cyclin D knockouts, 13
 cyclin D1, 9, 240, 271, 277, 284, 288, 290,
 294, 298, 299, 301, 304, 308, 310, 312
 cyclin D2, 281, 284, 288, 290, 298, 308
 cyclin D3, 240, 243, 288, 290, 291

- cyclin E, 8, 158, 159, 184, 185, 188, 190, 193,
 - 196, 208, 240, 272, 273, 275–278, 282,
 - 285, 289, 291–293, 296, 298–301, 304,
 - 305, 307, 309–312
- cyclin E knockouts, 15
- regulation of, 10
- substrates of, 11, 18
- cyclin-dependent kinase (Cdk), 36–38,
 - 42–45, 48, 50, 51, 230
- D-box, 152, 153
- Dbf4, 45, 46, 150
- deubiquitylating, 149
- deubiquitylating enzymes, 167
- development, 247, 271, 272, 276, 278, 279,
 - 281, 283–286, 288, 290–292, 294–298,
 - 300, 302, 304, 308–312
- DHFR, 33, 34
- differentiation, 183, 185, 192, 198, 206–210,
 - 232, 271, 272, 281, 285–287, 291, 292,
 - 294, 297, 300, 308, 311, 312
- DNA damage, 37, 38, 45–47, 49, 65, 68, 69,
 - 71, 72, 79, 163, 165, 257, 260, 264, 266
- aphidicolin, 72
- DNA replication interference, 66
- double-strand DNA breaks (DSBs), 66, 69,
 - 71, 79
- HU (hydroxyurea), 72
- ionizing irradiation (IR), 79
- junctions, 71
- MMC (mitomycin C), 79
- MMS (methyl methanesulfonate), 72
- RPA-coated ssDNA, 68, 69
- RPA-ssDNA, 72
- single-stranded DNA (ssDNA), 67
- UV (ultraviolet light), 72
- DNA polymerase α , 44
- DNA polymerase ϵ , 40, 47
- DNA repair, 66, 73, 77, 79, 80
 - base excision repair, 80
 - homologous recombination (HR), 76, 79
 - mismatch repair, 73, 80
 - NER (nucleotide excision repair), 73
 - non-homologous end joining [NHEJ], 76,
 - 79
 - nucleotide excision repair, 80
- DNA replication, 66, 78, 79, 165, 291, 305
 - BLM, 79
 - Claspin, 78
 - Mcm2, 78
 - Mus81, 79
 - RPA, 78
 - Dpb11, 46, 47
 - E2F, 9, 153, 160, 183–186, 188–192, 194–200,
 - 205, 208–210, 259–262, 266, 329, 334, 335
 - E2F knockout, 17
 - function of, 9, 21
 - E2F/DP, 236
 - E2F1, 185, 187, 188, 190, 191, 197, 198, 205,
 - 206, 209
 - E2F2, 188, 190
 - E2F3, 188, 190
 - embryogenesis, 285, 290
 - Embryonic, 291
 - Emi1, 153, 158, 160
 - endoreduplication, 291, 293
 - Esp1, 154
 - external transcribed spacer, 258
 - F-box, 156, 157
 - F-box motif, 156
 - F-box protein, 151, 156–158, 161, 162
 - Far1, 158
 - Fbw7, 157–160, 162, 163
 - fertility, 345, 354, 360
 - folliculogenesis, 355–357
 - G1, 150
 - G1 arrest, 161
 - G1 checkpoint, 77
 - G1 cyclin, 162, 168
 - G1 phase, 273, 276, 277, 311
 - G2 phase, 273, 280, 306
 - G2/M checkpoint, 77
 - gametogenesis, 343
 - geminin, 37, 41–43, 50, 150
 - genomic instability, 160, 238, 257
 - Gic1,2, 158
 - Gic2, 162
 - GINS, 46, 47, 51
 - granulosa cells, 354, 356
 - GRB2, 18
 - growth, 329, 330, 334
 - Grr1, 157, 162
 - GSK3 β , 159
 - hCdc4, 157
 - helicase, 31, 40, 41, 45, 48, 51
 - hematopoietic, 271, 287, 288, 308, 309, 312

- histone deacetylases, 186
 histone H3, 100
 histone methyltransferases, 186
 Hsl1, 150
 human disease, 230
 human papillomavirus (HPV), 228

 Id2 (inhibitor of differentiation), 237
 immortalization, 193, 195, 196, 258–262
 INCENP, 99, 101
 inhibitors, 98, 100, 103, 104, 271, 272, 279,
 285, 286, 296, 297, 306, 310, 311
 initiator, 32, 34, 35, 39
 INK4A/ARF, 262, 263
 interphase, 353
 intra-S checkpoint, 77
 Ipl1, 99

 KEN-box, 153
 kinase, 95, 98, 100, 101, 103
 kinase activity, 273, 274, 276, 277, 282, 291,
 293, 302, 304, 306, 307, 312
 kinetochores, 93–95, 98, 101–103, 163
 knockout mice, 12, 229, 260, 265

 lamin B2, 33
 leucine-rich repeat, 157, 161, 162
 Leydig cells, 354
 licensing, 37, 40–43, 46, 48, 51
 localization, 272, 303, 306
 LXCXE motif, 187

 M phase, 272, 273, 275, 279, 280, 293, 302,
 306, 307
 M-phase-promoting factor, 353
 Mad, 330
 Mad1, 94, 95, 97, 98, 101
 Mad2, 94, 95, 97, 98, 101, 104, 155, 164
 Mad3, 94, 98, 155, 164
 mammalian, 271–274, 276, 278, 279, 284,
 287, 313
 MAPK, 94, 102
 maturation promoting factor (MPF), 230
 MCAK, 100
 Mcm10, 43, 44, 46, 48, 51
 MCM2-7, 38–45, 48, 50, 51
 MDM2, 165, 166, 187, 193, 198, 262
 mediators, 75, 76
 – 53BP1, 75, 76
 – Brca1, 75, 76
 – Claspin, 75, 76
 – CtIP, 75
 – Mcm7, 75
 – Mdc1, 75, 76
 – TopBP1, 75
 MEFs, 287, 291, 294, 299, 301, 307, 309
 meiosis, 156, 279, 281, 282, 285, 304, 343,
 345, 353–360
 meiosis I, 345
 meiosis II, 345
 meiotic division
 – first, 156
 – second, 156
 meiotic prophase, 345, 353, 354
 Met30, 157, 161
 Met4, 158, 161, 163, 167
 metaphase, 353, 357
 metaphase-anaphase transition, 153
 methionine, 163
 MgcRacGTP, 100
 microtubules, 95, 99
 mitogen-activated protein kinase, 94, 102
 mitosis, 93–95, 97–99, 101–104, 149, 159,
 165, 166, 273, 275, 281, 293, 302, 305, 354
 – premature entrance into, 160
 mitotic checkpoint complex, 93
 mitotic checkpoint complex (MCC), 94
 mitotic divisions, 353
 mitotic spindle, 154, 163
 Miz1, 331, 333
 mouse, 271, 272, 277–279, 281, 283–285,
 288, 290–298, 300, 301, 304, 308, 310,
 312, 343, 345, 353, 356–360
 mouse embryonic fibroblasts (MEFs), 236
 mouse models, 229
 Mps1, 94, 101
 mutant
 – cdc, 157
 Myc, 190, 192, 195–197, 208, 329–337

 negative feedback loop, 166
 Nek2A, 150
 NLS, 190, 207
 Notch, 160

 oncogenes, 183
 oncogenic transformation, 183, 195, 196,
 200, 205, 208, 210
 oocytes, 281, 345, 353–360
 oogonial stem cells, 345
 Orc1, 158

- origin recognition complex, 32, 34–37
ovary, 286, 300, 302
ovulation, 345, 356, 357
oxidative stress, 257, 263–265
- p107, 183, 185, 187–192, 194–196, 198, 199, 205–210, 232
p130, 158, 161, 162, 183, 187–192, 194–196, 198, 199, 205–210, 232
p14^{ARF}, 259, 263, 265
p15^{INK4B}, 241
p16^{INK4A}, 184, 190, 192–194, 196, 197, 199, 240, 241, 285, 290, 309
p18^{INK4C}, 241
p19^{ARF}, 193–199
p19^{INK4D}, 241
p21, 158, 161, 162, 166, 241, 333, 335
p27, 10, 158, 161, 162, 241, 271, 273, 282, 286, 289, 293–301, 303–305, 307, 309–313
– function of, 10, 18
– p27 knockout, 18
– regulation of, 11
p53, 160, 163, 165, 166, 185, 193–199, 205, 206, 210, 229, 257–262, 264, 266
p57^{KIP2}, 241
pachytene, 353, 354, 356, 358, 359
paclitaxel (Taxol), 104
PCNA, 166, 167
Pds1, 150, 154, 164, 168
phosphatases, 164
phosphodegron, 158–161, 164, 165, 168
– Skp2, 161
phosphorylation, 95, 98, 99, 102, 103, 158, 184, 188–190, 200, 208, 232, 272, 273, 282, 291, 299, 303, 309–311
pituitary, 284–286, 294–297, 301, 305
placenta, 291, 293
Plk, 160, 161
pocket proteins, 185, 187–190, 192, 195, 196, 199, 200, 205–207, 209
polo-like kinase, 160
polycomb, 262
polyploidy, 159
Pop1, 157
Pop2, 157
positive feedback loop, 161
pRb, 183–199, 201, 205–210
pre-initiation complex, 46, 48
pre-replication complex, 48
pre-replication complex assembly, 159
primordial germ cells, 343, 358
processing, 71, 73, 74
– Exo1, 72
– exonuclease I, 72
– MRN complex (Mre11-Rad50-Nbs1), 73, 74
proliferation, 271, 287, 288, 290, 294, 296–298, 300, 302, 303, 305, 308–312, 329, 330, 332, 334–337, 354–356
proliferative life span, 263
prometaphase/metaphase arrest, 163
promoters, 186, 188, 190, 194, 209
prophase, 343, 353, 354, 358–360
proteasome, 149, 165–167
– 19S, 149
– 19S regulatory component, 166
– 20S catalytic core, 166
– 26S, 149
protein-ubiquitin ligases, 147, 151, 156
- quiescence, 272, 294, 301, 307, 308
quiescent, 272, 278, 291, 294
- Rad23, 149
Rad53, 164
Ras, 258, 261, 262, 264, 265
retinoblastoma (Rb), 9, 183, 184, 187, 188, 192, 194, 199, 200, 206–209, 227, 231, 257–260, 262, 266, 273, 279, 282, 284, 291, 292, 294–297, 299, 309–312
– function of, 9, 22
– Rb knockout, 16
– regulation of, 10
Rbx1, 152, 156
redundancy, 271, 272, 307, 313
regulatory particle, 149
replication, 272, 273, 277, 281, 282, 289, 291, 292, 302, 305
– transcription and, 34
– viral, 43, 50
replication factors, phosphorylation of, 36, 37
replication origin, 31–36
replicator, 32, 35, 36
rereplication, 36, 38, 41, 49
restriction point, 7, 273
– cyclohexamide, 7
– early mRNAs, 9
– late mRNAs, 9
– START, 7

- RhoA, 18
 ring finger motifs, 152, 156
 Roc1, 152, 156
 ROS, 258, 260, 263–266
 Rum1, 158, 159
- S phase, 160, 168, 184, 189, 190, 192, 232,
 271–273, 276, 278, 279, 284, 286, 289,
 292, 296, 299, 301, 305, 307, 309, 311, 312
 S-adenosyl methionine (SAM), 161
 SAM, 163, 167
 Scc1, 154
 SCF, 11, 151, 152, 156, 158
 SCF ^{β -TrCP}, 160, 164, 165
 SCF^{Cdc4}, 158–160, 168
 SCF^{Grr1}, 162
 SCF^{Met30}, 161, 163, 167
 SCF^{Pop1/Pop2}, 159
 SCF^{Skp2}, 161, 162, 165
 securin, 150, 154, 155, 164, 168
 seminiferous tubules, 345, 354, 355, 357
 senescence, 185, 190, 193, 194, 196, 244,
 257–266
 sensors, 67
 – 9-1-1 complex, 69, 71
 – ATR-ATRIP, 67, 68, 71
 – Hus1, 69
 – Mec1-Ddc2, 67, 68
 – Rad1, 69
 – Rad17, 69
 – Rad17 complex, 71
 – Rad9, 69
 separase, 154, 168
 Sertoli cells, 345, 354, 357
 serum starvation, 291, 307, 309
 serum stimulation, 8
 – Ras/Map kinase pathway, 18
 – signal transduction, 8
 Sic1, 151, 158, 159, 168
 sister chromatid, 154, 156
 skin carcinogenesis, 261
 Skp1, 151, 156, 163
 Skp2, 150, 157, 161, 162, 273, 293, 296
 Sld2, 47
 Sld3, 45, 46
 Slimb, 157
 SOS, 18
 sperm, 345, 354, 356, 360
 spermatocytes, 345, 353–355
 spermatogenesis, 343, 353, 355, 357, 359
 spermatogonia, 345, 353–355
 spindle, 93–95, 97–99, 101–104, 154, 168
 spindle assembly checkpoint, 93, 99, 101
 substrate phosphorylation, 151
 SUMO, 166
 sumoylation, 166, 167
 survivin, 100
 Swe1, 158, 161
 synapsis, 353, 359
 synaptonemal complexes, 354, 359
- telomerase, 257, 258, 260, 265
 telomere, 80
 Telomere attrition, 264
 telomere erosion, 262
 testis, 281, 282, 284–286, 345, 356
 tetratricopeptide repeat, 152
 transcription, 166, 355, 356
 transcription factors, 183–185, 188, 190,
 191, 208–210, 237, 332, 333, 337
 transcriptional repressors, 333
 transformation, 258, 259, 261, 266
 transformed cells, 329
 transgenic mice, 229
 β -TrCP, 157, 158, 160, 161
 tumor, 183, 184, 187, 188, 193, 195–197, 199,
 200, 205–208, 210, 227, 271, 284–286,
 294, 295, 297–300, 302, 303, 310–312,
 329, 333, 335–337
 tumor spectrum, 245
 tumor suppressor, 183, 187, 205, 206,
 257–259, 262, 266
 tumorigenesis, 183, 185, 193, 195–197, 199,
 200, 205, 207–210
 tyrosine 15, 160
- Uba domains, 149
 Ubc10, 153
 ubiquitin, 148, 149
 – conjugating enzymes, 147
 – ligase, 152
 – ubiquitin-mediated proteolysis, 147, 149
 ubiquitin conjugating enzyme, 151, 153
 ubiquitin-proteasome pathway, 152
 ubiquitylation, 153, 155, 161, 165
 Ubl domain, 149
- WD40 repeat, 157, 158, 160, 161
 Wee1, 158, 160, 161, 230
 Xkid, 150