

Index

a

AAV vectors, *see* adeno-associated virus vectors
abacavir, pharmacogenetic tests 264, 265
ABC transporters 218, 321
acetylcholine 26
acetylsalicylic acid 3
aCGH (array CGH) 205–207
aciclovir 146, 149
ACT (artemisinin combination therapy) 168
activation, B-cell 35
acute lymphoblastic leukemia (ALL) 115–117
– genetic testing 202
acute myelogenous leukemia (AML) 115
ADA-SCID 271, 299
adalimumab 243
adamantane derivatives 149
adaptive immune system 33–36
ADC (antibody–drug conjugate) 91, 92, 245
ADCC (antibody-dependent cellular cytotoxicity) 36, 241
adeno-associated virus (AAV) vectors 264, 265
– RNAi delivery 321
adenosine deaminase gene 271
adenoviral vectors 262–264
– RNAi delivery 321
adenylyl cyclase (AC) 28, 29
adult stem cells 282–286
– medical applications 293–296
adverse drug reactions (ADRs) 217–223
– drug hypersensitivity 226, 227
adverse selection 349
Aequorea victoria 57, 58
affinity purification 193
age-related macular degeneration (AMD) 244, 245
– aptamers 334, 339–341
– RNA interference 322
– stem cell therapies 301, 302
AIDS 34
– clinical latency 127, 128
– *see also* HIV
AIDSVAX B/E 139
albumin 112
alkaloids, discrimination 336
ALL, *see* acute lymphoblastic leukemia
allogenic HSCT 295

alternative splicing 18
alternatives to animal testing 52–54
Altman, Sydney 311
ALVAC-HIV-1 139
Ames test 14
amines, biogenic 26
amino acids, derivatives as hormones 27
– genetic code 22
aminoacyl-tRNA synthetases 19
aminoglycosides 163
AML (acute myelogenous leukemia) 115
amniocentesis 200–203
ampicillin 162
AmpliChipTM CYP450 222
amplification refractory mutation system (ARMS) 207, 208
amyotrophic lateral sclerosis (ALS) 298, 299
anaphase 8, 9
anaplastic lymphoma kinase (ALK) 94
androgen receptor (AR) 111–114
androgens 111, 112
Angelman syndrome (AS) 21
– genetic testing 202, 206
– genomic imprinting 62
angiogenesis pathway 92, 93
– cancer 87, 88
– gene therapy 273
Angiozyme 314
animal models, alternatives to 52–54
– biomedical research 51–56
animals, transgenic 236–238
annealing, primers 41, 44
annexins 111
Anopheles mosquito 167
anti-EGFR therapy 104
anti-mRNA strategies 304, 305
antibiotics 160–166
– cellular targets 162
– resistance against 164–166
antibodies, antibody–drug conjugates (ADC) 91, 92, 245
– antibody-dependent cellular cytotoxicity (ADCC) 36, 241
– crystal structure 3
– diversity 36
– immobilized 141
– immune system 32–36

– monoclonal, *see* monoclonal antibodies
 – nomenclature 243
 – plantibodies 238
 anticipation, genetic 69
 anticoagulation system 251–254, 334, 342
 anticodon loop 19
 antigen-presenting cells (APCs) 31–35, 107, 108
 – dendritic cells 133
 antigenic drift 131
 antigenic shift 131, 132
 antigens 31–36
 Antinori, Severino 281
 antisense oligonucleotides (AS ONs) 76, 303–311
 – miRNA inhibitors 329, 330
 – and RNAi 317
 antiviral susceptibility testing 142
 antiviral therapy 142–150
APC gene 100–103
 apes, animal models 52
 apolipoprotein E (ApoE) 199, 200
 apoptosis 9, 10
 apoptosome 10
 apoptotic protease activating factor 1 (APAF1) 10
 applications, AS ONs 308–311
 – ribozymes 312–315
 – RNAi 321–325
 applied ethics 346
 approval, drug development stage 3, 4
 aptamers 333, 344
 – binding partners 334
 – PEG-coupled 339
 – stabilization 337
 AR (androgen receptor) 111–114
 archaea, *Pyrococcus furiosus* 42
 arming, oncolytic viruses 264
 ARMS (amplification refractory mutation system) 207, 208
 array comparative genomic hybridization (aCGH) 205–207
 arrays, DNA, *see* DNA microarrays
 artemisinin combination therapy (ACT) 168
 artemisinin derivatives, bioavailability 168
 artificial chromosomes 171, 172
 artificial miRNA 318
 artificial organs 53, 54
 AS, *see* Angelman syndrome
 AS ONs, *see* antisense oligonucleotides
 Aspirin, *see* acetylsalicylic acid
 assembly, genome 172, 173
 asthma 80, 81
 asymmetric stem cell division 283
 athletes, doping 248, 268
 ATP-binding pocket 91, 119
 – ABC transporters 218, 321
 ATP hydrolysis 11, 70, 218
 ATP sulfurylase 47, 48
 ATP synthase 78, 79
 – mycobacterial 158
 ATryn 238

attenuated viruses 134
 autocrine signaling 27
 autologous bone marrow 295
 autologous ESCs 282
 autosomal dominant disorders 62, 64–69
 autosomal recessive disorders 62, 69–74
 axons 26
 azidothymidine (AZT) 145

b

B-cell activation 35
Bacillus Calmette–Guérin (BCG) 158, 160
 bacillus shape 155
 bacteria 153–166
 – *Bacillus subtilis* 73, 234, 335
 – codons 234
 – lipopeptides 343
 – metabolism 160
 – mycobacterial ATP synthase 158
 – *Mycobacterium bovis* 160
 – *Mycobacterium tuberculosis* 153, 154, 157
 – *Penicillium notatum* 161
 – recombinant protein production 233, 234
 – ribosomes 163
 – *Thermus aquaticus* 42
 – toxins 158, 159
 – *Vibrio cholerae* 157
 – *Y. pestis* 156
 bacterial artificial chromosomes (BACs) 172
 “bad” cholesterol 66
 baker’s yeast, *see* *Saccharomyces cerevisiae*
 bat, *Desmodus rotundus* 253, 254
 BBB, *see* blood–brain barrier
 BCG (bacillus Calmette–Guérin) 158, 160
bcr-abl1 fusion gene 118, 119
 Becker muscular dystrophy (BMD) 75–77, 310
 beginning of human life 350
 belimumab 180
 Benlysta 180
 “Berlin Patient” 148
 Betaferon/Betaseron 250
 bevacizumab 106, 107
 Biacore experiment 59
 bifunctional siRNAs 320
 bilharzias 168
 bioavailability, artemisinin derivatives 168
 – AS ONs 308
 – oral 2, 143
 – protease inhibitors 147, 148
 biobetters 232
 bioengineered tooth 296
 bioethics 345–354
 biogenic amines 26
 bioinformatics 40
 – genome sequencing 176
 – RNA secondary structure 306
 – SIB 189

- biological communication 26–30
- biomarkers 329, 334
- biomedical research, animal models 51–56
- biopsy, embryo 352
- biosimilars 231
- biotinylated probes 184, 185
- bird flu 131
- bispecific mAbs 240, 245
- blastocyst 278, 279
- blastomer, embryo biopsy 352
- blood, angiogenesis
 - cancer, *see* leukemia
 - cells 30
 - coagulation factors, *see* coagulation factors
 - coagulation pathway 24
 - hematological malignancies 114
 - *see also* angiogenesis
- blood–brain barrier (BBB) 73, 250
- BMD, *see* Becker muscular dystrophy
- bone marrow, autologous 295
 - hematological malignancies 114
- BRAF* 95, 96, 101, 104, 105, 224
- BRCA1/2* 92, 109, 110, 199
 - bioethics 348, 349, 353
 - breast cancer 88–93
 - *breast cancer 1, early-onset (BRCA1)* gene 92, 109, 110, 199
 - molecular profiling 89
 - overexpressing Her2 91, 92, 224, 243, 314
 - trastuzumab 243
 - bridge amplification 48
 - Brown, Timothy Ray 148
 - Bruton tyrosine kinase (BTK) 120
 - BSE 151
 - “bubble boy disease” 271
 - budding, virus life cycle 126
 - burgers, stem cell 296, 297
 - bystander effect 273
 - *Caenorhabditis elegans* 170, 176, 188
 - PTGS 315
 - c**
 - caffeine 336
 - CAG repeats 68
 - CALAA-01 nanoparticle 325
 - Calmette, Albert 160
 - cAMP (cyclic AMP) 29
 - Campbell, Keith 237
 - cancer 87–122
 - apoptosis 9
 - AS ON-drugs 310
 - breast, *see* breast cancer
 - colorectal 99–105
 - complexity 98, 99
 - cutaneous T-cell lymphoma 21
 - fluorescence karyotyping 206
 - gene therapy 272, 273
 - hematological malignancies 114–121
 - hepatocellular carcinoma 96–99
 - HNSCC 93, 263
 - kidneys 65–67, 105
 - leukemia, *see* leukemia
 - lung, *see* lung cancer
 - molecular oncology 85–122
 - prognostic marker genes 40
 - prostate 109–114
 - RCC 105–109
 - ribozyme drugs 314
 - stem cell model, *see* CSCs
 - two-color microarrays 39
 - WGS 211
 - Candida albicans* 166
 - CAPB* 109
 - Capecchi, Mario R. 54
 - capping 16, 17
 - capsid 125
 - carcinoma, *see* cancer
 - cardiomyocytes 269, 283, 289–293, 299–302
 - cardiovascular malformations, Marfan’s syndrome 67
 - CaroRX 238
 - carriers (persons), bioethics 345, 349, 353
 - genetic disorders 62
 - genetic testing 198–201, 204
 - germline mutations 103
 - heterozygous, *see* heterozygous carriers
 - homozygous, *see* homozygous carriers
 - oncogene mutations 92, 102, 103, 110
 - SCID mutations 270
 - viruses 130, 148
 - carriers (of substances), genetic information 311, 312
 - proteins 160
 - siRNAs 320
 - SLC3OA8 82
 - cartilage formation, MSCs 296
 - caspases 9
 - castration-resistant prostate cancer (CRPC) 112
 - categorial imperative 347
 - β-catenin pathway 102
 - caterpillars, swallowtail 189
 - cathepsins 25
 - cationic lipids 320
 - CCAAT box 15
 - CD (cluster of differentiation) system 33
 - CD4⁺ cells 33, 34, 128, 147, 148
 - CDC (complement-dependent cytotoxicity) 241
 - CDK 4/6 pathway 90, 91
 - cDNA 38, 39
 - Cech, Thomas 311
 - Celera 176, 182
 - cell-based immunotherapy 133
 - cell-based SELEX 336
 - cells, APCs 31–33
 - apoptosis 9, 10
 - blood 30

- cell cycle 8, 9
- cell walls 155
- CHO 235, 236, 278
- embryonic kidney 139, 235
- ESCs, *see* ESCs
- eukaryotic 5
- fluorescence-activated sorting 58, 59
- heat-fixed 155
- hESCs, *see* hESCs
- High Five 235
- human 4–10
- immune system 32
- insect 235
- malignant, *see* malignant cells
- mammalian 235, 236, 319
- MSCs, *see* MSCs
- necrotic 9
- normal and pathological processes 2
- plant cell cultures 238
- post-mitotic 283
- potency 278
- recycling system 8
- somatic 13
- stem, *see* stem cells
- type-switching 289, 290
- waste disposal 8
- β-cells, pancreatic 300
- cellular entry, HIV 147
- cellular immunity 33, 34
- “cellular power plants” 6
- cellular targets, antibiotics 162
- Center for Genomics and Transcriptomics (CeGaT) 211
- centimorgan (unit) 173
- central dogma of molecular biology 10
- centromere 5, 6
- cephalosporins 162, 163
- Cerezyme 255
- Cervarix 138
- cetuximab, pharmacogenetic tests 216
- CF, *see* cystic fibrosis
- CFTR* gene 65, 70, 198, 210, 272
- CGH (comparative genomic hybridization) 205–207
- chain-terminator method 46
- Chalfie, Martin 58
- CHARGE syndrome 205
- CHEK2* 109
- chemical labeling 192
- chemical synapse 26
- chemically induced pluripotent stem cells (CiPSCs) 288
- “children of the night” 73, 74
- chimeric mAbs 242
- chimeric organisms 280
- chimeric protein drugs, *see* fusion proteins
- chimpanzees, genome 179
- Chinese hamster ovary (CHO) cells 232, 235–238, 247–254
 - monoclonal antibodies 194
 - stem cell preparation 278
- cholera 157
- cholesterol 65–67
- cholinergic neurons 27
- chorionic villus sampling (CVS) 200–203
- choroidal neovascularization 339
- chromatin 5
 - apoptosis 9
 - chromatin remodeling complex 6
 - chromophobe RCC 106, 108
 - chromosomes 5, 6
 - abnormalities 202–207
 - artificial 171, 172
 - cell cycle 9
 - chromosomal instability pathway 100
 - chromosome walking 173, 174
 - eukaryotic 12
 - X-chromosome inactivation 74
 - chronic feeling of hunger 64
 - chronic kidney disease 231, 247
 - chronic myelogenous leukemia (CML) 115–121
 - genetic testing 202, 205
 - Philadelphia chromosome-positive patients 222
 - CIMP (CPG-island methylator phenotype) pathway 101
 - circular DNA 130
 - circulating miRNAs 329
 - cisternal space, *see* lumen
 - CJD (Creutzfeldt–Jakob disease) 151
 - clear cell RCC 105, 106
 - clinical latency, AIDS 127, 128
 - clinical trials 3, 4
 - antisense oligonucleotides 308–311
 - aptamers 340
 - gene therapy 270–275
 - ribozymes 314, 315
 - RNAi 322–325
 - stem cell therapies 301, 302
 - Clonaid 281
 - clonal evolution model 285
 - clone contig approach 175
 - cloning 170–172
 - molecular technologies 230
 - reproductive, *see* reproductive cloning
 - therapeutic 281, 282, 351, 352
 - vectors 170–172
 - *Clostridium tetani* 159
 - cloverleaf structure 18, 19
 - cluster of differentiation (CD) system 33
 - clustered regulatory interspaced short palindromic repeats (CRISPR) 274, 275
 - CML, *see* chronic myelogenous leukemia
 - coagulation factors 207, 225, 237, 238, 251–254
 - anticoagulation system 334, 342
 - gene therapy 257, 269, 276
 - coccus shape 155
 - code, genetic, *see* genetic code
 - codeine, conversion to morphine 220
 - pharmacogenetic tests 216

- codons 13, 14, 22–24
 – bacteria 234
 colectomy 101
 Collins, Francis 176
 colony-stimulating factors (CSFs) 247–249
 color blindness, red-green 75
 colorectal cancer 99–105
 combination therapy 148
 – ACT 168
 committed progenitors, hematopoiesis 31
 communication, biological 26–30
 – intercellular 26
 comparative genomic hybridization (CGH) 205–207
 complement-dependent cytotoxicity (CDC) 241
 complement system 32, 33
 complementary DNA, *see* cDNA
 complexity of cancer 98, 99
 computer models, personalized medicine 187, *see also*
 bioinformatics
 concordance 82
 conditional gene inactivation 55
 confocal microscopes 57
 conventional karyotyping 203
 copy number variations (CNVs) 182, 184
 cosmid 171
 counter-SELEX 336
 cowpox 132
 CPE (cytopathic effects) 130
 – virus detection 139, 140
 CpG motifs 19, 20, 101, 307
 – CpG oligonucleotides 343, 344
 Cre/lox system 54–56
 Creutzfeldt–Jakob disease (CJD) 151
 Crick, Francis 10
 CRISPR (clustered regulatory interspaced short palindromic repeats) 274, 275
 cristae 6
 cross-pollination 238
 crystal structure, antibodies 3
 – hammerhead ribozymes 315
 – X-ray crystallography 194
 CSCs 284–286
 CSFs (colony-stimulating factors) 247–249
 cutaneous T-cell lymphoma 21
 CVS (chorionic villus sampling) 200–203
 cyclic AMP (cAMP) 29
Cyclin D1 89
 cylindromatosis, familial 321
 cystic fibrosis (CF) 70, 71, 298
 – cystic fibrosis transmembrane conductance regulator gene, *see* CFTR
 – gene therapy 272
 – molecular diagnosis 210
 cytochrome C, apoptosis 10
 cytochrome P450 superfamily (CYP) 218–220
 cytogenetics, hematological malignancies 115–117
 cytokines 250, 251
 cytokinesis 8, 9
 cytomegalovirus 309, 310
 cytometry, flow, *see* flow cytometry
 cytopathic effects (CPE) 130
 – virus detection 139, 140
 cytoplasm 5
 cytosol 5
 cytosolic protein degradation 25
 cytotoxicity, CDC/ADCC 36, 241
- d**
- 2D gel electrophoresis 189–192
 dabrafenib, pharmacogenetic tests 216
 Dacogen 21
 DAPI 57
 dasatinib, pharmacogenetic tests 216
 databases, GenBank sequence database 181
 – GeneTest 198
 – OMIM 64
 ddNTP (dideoxynucleotide triphosphate) 46
 deadenylation 327
 debrisoquine 219
 decapping 327
 decoy oligonucleotides 342–344
 degradation, nucleolytic 307, 314, 337
 – proteins 25, 26
 deletions, chromosome abnormality 203
 – nucleotides 14
 delivery, gene transfer 259–267
 – ribozymes 314
 – RNAi drugs 320–322, 342
 – targeted siRNAs 320, 321, 342
 denaturation, PCR 41, 44
 dendrites 26
 dendritic cells 31, 344
 deoxyribonucleic acid, *see* DNA
 dephosphorylation 28
Desmodus rotundus 253, 254
 desmoteplase 253, 254
 development, drugs 3, 4, 226, 227
 DGC (dystrophin–glycoprotein complex) 76
 DGCR8 cofactor 325
 diabetes mellitus 81–83, 246
 – stem cell therapies 299, 300
 diagnosis, molecular 207–213
 diagnostic test, genetic 198
 Dicer 316
 dideoxynucleotide triphosphate (ddNTP) 46
 differentially methylated regions (DMRs) 289
 differential in gel electrophoresis (DIGE) 190
 differentiation, stem cells 291–293
 dihydrotestosterone (DHT) 112
 dinucleotides, CpG 19, 20, 101, 307, 343, 344
 direct hybridization 39
 direct reprogramming 289–291
 direct-to-consumer genetic testing 350
 directed differentiation 291, 292, 294

- diseases, AIDS, *see* AIDS
 - apoptosis 9
 - AS, *see* Angelman syndrome
 - autosomal dominant disorders 64–69
 - autosomal recessive disorders 69–74
 - cancer, *see* cancer
 - CHARGE syndrome 205
 - cholera 157
 - chronic kidney 231, 247
 - cystic fibrosis, *see* cystic fibrosis
 - definition of severe genetic disorders 353
 - disease-relevant genes 181
 - disease-targeted sequencing 210
 - Down syndrome 202
 - eradication 135
 - erectile dysfunction 30
 - fatty liver disease 97
 - Gardner syndrome 101
 - Gaucher disease 254
 - genetic carriers 62
 - genetic disorders 61–83
 - genomic imprinting 21
 - heart 300
 - Huntington’s, *see* Huntington’s disease
 - hypercoagulability disorder 44
 - immune system 30
 - infectious, *see* infectious diseases
 - inflammatory, *see* inflammatory diseases
 - Leber’s congenital amaurosis (LCA) 271, 272
 - Lesch–Nyhan syndrome 298
 - Lynch syndrome 102, 103
 - malaria 69, 166–168
 - Miller syndrome 184
 - miRNAs 327–330
 - molecular medicine 2
 - monogenic 271, 272, 276, 353
 - mucolipidosis II 8
 - multifactorial 80, 276, 298
 - myelodysplastic syndromes 120
 - Parkinson’s, *see* Parkinson’s disease
 - plague 156, 157
 - polygenic disorders 80–83
 - prions 151
 - PWS, *see* Prader–Willi syndrome
 - respiratory chain genetic defects 79
 - Trisomy 202
 - tuberculosis 157, 158
 - distortion, DNA helix 74
 - DMD, *see* Duchenne muscular dystrophy
 - DMRs (differentially methylated regions) 289
 - DNA 4–6
 - circular 130
 - double-strand breaks (DSBs) 92
 - dyes binding 44
 - ENCODE 186–188
 - exogenous 54
 - helix distortion 74
 - helper 260
 - intergenic 178
 - “junk” 174, 177, 186
 - methylation 19, 20
 - minicircle vectors 267
 - mitochondrial, *see* mtDNA
 - molecular diagnosis sequencing 209–212
 - nonviral gene transfer 266
 - replication, *see* replication
 - single-strand breaks (SSBs) 92
 - testing, *see* genetic testing
 - transcription, *see* transcription
 - triplet repeats 68
 - DNA enzymes (DNAzymes) 304
 - DNA microarrays 38–40
 - heat map 40
 - molecular diagnosis 212, 213
 - risk assessment 213
 - DNA polymerases 11, 12
 - DNA vaccines 134, 139
 - DNA viruses 125, 126
 - “Doktor Schnabel von Rom” 157
 - Dolly 237
 - Domagk, Gerhard 160, 161
 - dominant genetic disorders 62
 - dopamine 26
 - dopaminergic neurons 292
 - from iPSCs 300, 301
 - Parkinson’s disease 273
 - doping by athletes 248, 268
 - dornase alpha 71
 - dorsal root ganglia (DRG) 308
 - double-strand breaks (DSBs) 92
 - double-stranded RNA (dsRNA) 315–320, 327
 - Down Syndrome, genetic testing 202
 - “driver” mutations 93
 - droplet secretion 130
 - Drosha 325
 - Drosophila melanogaster* 188
 - druggable genome 303
 - drugs, aciclovir 146, 149
 - ADC 91, 92, 245
 - adjuvant therapy 104
 - affecting epigenetic modulation 20, 21
 - antibiotics 160–166
 - antiviral 143
 - aptamer-based 339, 340
 - AS ONs 308–311
 - asthma 80
 - AZT 145
 - basics of molecular medicine 2
 - clear cell RCC 106, 107
 - cystic fibrosis 71
 - development 3, 4, 226, 227
 - everolimus 90
 - exemestane 90
 - genotype adjustment 219

- hormonal therapeutic strategies 112
- hypersensitivity to 226
- impact of HGP 180
- metabolism 218, 222
- multidrug resistant pathogens 164–166
- multiple combinations 142
- off-target effects 107, 319
- pan-drug resistant (PDR) strains 166
- pertuzumab 91, 92
- pharmacogenetics 215–227
- recombinant protein 229–256
- RNAi 323
- small molecular 3
- sorafenib 97, 98
- specificity 303
- tamoxifen 90
- targeting 222–226
- therapeutic enzymes 254, 255
- therapeutic mAbs 240
- therapeutic window 216, 217
- toxicity 217, 226
- uptake and transport 217, 218
- *see also* delivery, therapies
- DSBs (double-strand breaks) 92
- dual HER2 targeting 91, 92
- dual SMAD inhibition (dSMADI) 291, 292
- Duchenne muscular dystrophy (DMD) 75–77,
 - AS ON-drugs 310
 - genetic testing 204
- duplication, chromosome abnormality 203
- dyes, double-stranded DNA-binding 44, *see also* stains
- dystrophin* 204
- dystrophin–glycoprotein complex* (DGC) 76
- e**
- Ebola virus 150, 311, 323
- echinoderm microtubule-associated protein like-4 (EML4)* 94
- editing, targeted 274
- E2F transcription factor 342, 343
- effector caspases 9
- efflux transporter 165
- EGFR, *see* epidermal growth factor receptor
- electron microscopy, virus detection 140
- electrospray ionization (ESI) 190, 191
- ELISA (enzyme-linked immunosorbent assay) 140, 141
- elongation, PCR 41–45
 - translation 23, 24
 - transcription 15, 16
- EMA (European Medicines Agency) 4
- embryoid bodies 280
 - iPSCs 289
- embryonic development, bioethics 350–352
- embryonic stem cells, *see* ESCs
- embryos, biopsy 201, 202, 352
- EML4-ALK 94
- EMs (extensive metabolizers) 220, 221
- Emulsion PCR (EmPCR) 48
- enantiomers, spiegelmers 337, 338
 - warfarin 225
- Enbrel 249
- Encyclopedia of DNA Elements (ENCODE) 186–188
- endocrine hormones 27
- endocrine therapy resistance 90
- endocytosis 94, 266, 308, 320
 - receptor-mediated 66
 - virion import 131
- endogenous delivery, ribozymes 314
- endogenous insulin 245, 246
- endogenous siRNAs 316
- endonucleases 316
- endophagocytosis, mitochondria 7
- endoplasmic reticulum (ER) 4, 5, 7, 8
- endosymbiotic hypothesis 7
- endotoxins 158, 159
- enfuvirtide 147
- engineered human skin constructs 53
- envelope, nuclear 5
 - viruses 125, 126
- environmental factors, asthma 80
 - diabetes mellitus 81–83
 - mutations 14
- enzyme-linked immunosorbent assay (ELISA) 140, 141
- enzymes, DNA enzymes 304
 - DNA polymerases 11, 12
 - Drosha 325
 - drug metabolizing 218–222
 - enzyme replacement therapy 271
 - HMG-CoA-reductase 66
 - inhibitors 144, 145
 - phenylalanine hydroxylase (PAH) 72, 73
 - recombinant 254, 255
 - ribozymes, *see* ribozymes
 - RNAP 14
 - TERT 12, 13
 - therapeutic 254, 255
 - VKOR 225
- epidermal growth factor receptor (EGFR) 93
 - colorectal cancer 103, 104
 - signaling cascade 224
- epifluorescence microscope 57
- epigenetics 19–21
 - genetic disorders 62–64
 - hematological malignancies 120
- episomal therapeutic genes 258
- ER (endoplasmic reticulum) 4, 5, 7–8
- ER-positive breast cancer 88
- eradication of infectious diseases 135
- erectile dysfunction 30
- erythrocytes 31, 69, 279
 - EPO doping 268
 - hemagglutination assay 140
 - sickle-cell anemia 65, 167, 168
- erythropoiesis-stimulating agents (ESAs) 247–249
- erythropoietin (EPO) 247–249

– RepoxygenTM 268
Escherichia coli 154, 155
– genome cloning 171
– *in vitro* expression of foreign genes 233
– inclusion bodies 234
– plasmids 230
escort aptamers 342
ESCs 279–282, 296–299
– bioethics 350–352
– directed differentiation 291–294
– therapeutic applications 299–302
ESI (electrospray ionization) 190, 191
estrogen pathway 90
etanercept 249
ethical issues, genetic testing 69, 348–350
– molecular medicine 345–354
– preimplantation genetic diagnosis 352–354
– stem cell research 350–352
ETS gene family 114
euchromatin 6
eugenic programs 345
eukaryotic cells, *see* cells
eukaryotic chromosomes 12
eukaryotic pathogens 153, 154, 166–168
eukaryotic release factor 1 (eRF1) 24
European Medicines Agency (EMA) 4
Evans, Martin 54, 279
everolimus 90
– RCC 107
ex vivo gene therapy 259, 271
– retroviral vectors 262
excitation filter 57
exemestane 90
exogenous delivery, ribozymes 314
exogenous DNA 54
exons 17
– exome sequencing 184, 185, 211, 212
– exon-skipping strategy 306, 310
5' exonuclease assay 45
exotoxins 158, 159
ExPASy 189
extension reaction, primer 39
extensive metabolizers (EMs) 220, 221
extrinsic pathway, apoptosis 9, 10
– blood coagulation 251
Exubera 247

f

ΔF508 mutation 70
Fab fragments 35, 240, 244
Fabrazyme 236, 255
FACS, *see* fluorescence-activated cell sorting
familial adenomatous polyposis (FAP) 100, 101
familial cylindromatosis 321
familial hypercholesterolemia (FH) 64–67
fatty liver disease 97
FDA (Food and Drug Administration) 4

feeder cells 279–281
female patients, *see* women
fibrillarin 18
fibrillin-1 68
fibrin clots 342
fibroblast growth factor receptor (FGFR) 98
fibroblasts, reprogramming 286
– transdifferentiation 289, 290
fibronectin 253
fibrosis, cystic, *see* cystic fibrosis
Filgrastim 249
fixed probes 38
flagellin 343
Fleming, Alexander 160, 161
floor plate intermediate 293
flow cytometry 58, 59
FLP–FRT system 56
FLT3 119
flu, *see* influenza viruses
Flucelvax 137
fluorescence-activated cell sorting (FACS) 58, 59
– HSCT 295
– stem cells 291
fluorescence *in situ* hybridization (FISH) 118
– genetic testing 203–206
fluorescence microscopy 56–58
Fluorescence Resonance Energy Transfer (FRET) 44, 45
fluorescence signal, qPCR 42–45
fluorescent labels 38
– AS ONs 308
– qPCR 44, 45
– sequencing 46–50
fluorophores 46
folding, proteins 7
follow-on biologics 231
fomiversen 308
Food and Drug Administration (FDA) 4
fosfarnet 144
founder effect 65, 71
FOXO2 179, 180
fragment length analysis 208
frameshift mutations 13
fungi 153, 154, 166
– *in vitro* expression of foreign genes 234, 235
fusion gene, *bcr-abl1* 118, 119
fusion proteins 249, 250

g

G-CSF 249
G protein-coupled receptors (GPCRs) 28, 29
α-galactosidase 254
Gallo, Robert 127
gamma aminobutyric acid (GABA) 26
ganciclovir 273
ganglioside GM2 71, 72
gapmers 307
Gardasil 138

- Gardner syndrome 101
 Gaucher disease 254
 GEF (guanosine exchange factor) 24
 gel electrophoresis, 2D 189–192
Genasense™ 310
 GenBank sequence database 181
 gene expression 6, 10–26
 – epigenetic regulation 19–22
 – plasmids 230
 – profiling 38
 – tissue specificity 267–270
 gene therapy 257–276
 – applications 270–275
 – clinical targets 271
 – combinations with stem cell therapies 301
 gene transfer, methods 259–267
 – nonviral 266, 267
 – tissue specificity 267–270
 – viral 259–265
 genes, conditional inactivation 55
 – disease-relevant 181
 – gene-based immunotherapy 272, 273
 – gene doping by athletes 268
 – “gene gun” 259, 266
 – HIV-1 128
 – overexpressing 52
 – protein-coding 176
 – recombinant expression 232–238
 – tumor suppressor, *see* tumor suppressor genes
 GeneTest database 198
 genetic anticipation 69
 genetic code 22
 genetic disorders 61–83
 – severe 353
 – *see also* diseases
 genetic engineering 171
 genetic testing 197–214, 347–350
 – direct-to-consumer 350
 – ethical issues 69, 347–350
 – privacy issues 227
 genome, and Human Rights 349
 – composition 178
 – druggable 303
 – genome engineering 274, 275
 – HGP, *see* HGP
 – human, *see* human genome
 – individual 182
 – mapping and assembly 172, 173
 – Neanderthal Genome Project 179, 180
 – repetitive elements 177
 – sequencing 170–174
 – viruses 125
 – WGS, *see* whole genome sequencing
 1000 Genomes Project 184–186
 Genomic Grade Index (GGI) 89, 213
 genomic hybridization, comparative 205–207
 genomic imprinting 21, 62–64
 genomic plasticity, *Plasmodium* 168
 genomics 169–188
 – pharmacogenomics 215–227
 genotype, drug response 215
 genotype–lifestyle interaction, diabetes mellitus 82
 genotyping 39
 germ cell therapy 258, 259
 germ layers 278
 germinal mutations 13
 Giesma stain 203, 204
 glucagon-like peptide-1 (GLP-1) 247
Glutathione S-transferase gene (GSTP1) 111
Glybera™ 258
 glycopeptide antibiotics 162
 glycoproteins 239
 – fibrillin-1 68
 – transmembrane 129
 – *see also* antibodies
 glycosylation, proteins 7
 goats, transgenic 238
 Gold, Larry 336
 Golgi apparatus 4, 5, 7, 8
 Gram, Christian 154
 Gram-negative bacteria 154, 155
 – lipopolysaccharides 159
 Gram-positive bacteria 154, 155, 161
 Gram stain 155
 granulocytes 31
 green fluorescent protein (GFP) 57, 58
 – silencing 315
 growth factors 247–249
GSTP1 (Glutathione S-transferase gene) 111
 guanosine, CpG dinucleotides 19, 20
 guanosine exchange factor (GEF) 24
 Guérin, Camille 160
 guide strand 317
 Guthrie test 73
 gutless vectors 263
- H**
- HAART (highly active antiretroviral therapy) 148
Haemophilus influenzae, genome sequencing 170
 hair removal, siRNAs 324
 hammerhead ribozymes 311–315
 haploinsufficiency 65
 haplotype blocks, inheritance 183
 HapMap, *see* International HapMap Project
 HAR1 (human accelerated region 1) 178
 HATs (histone acetyltransferases) 21
 Hawking, Stephen 298
 HCM (hypertrophic cardiomyopathy) 210, 211
 HD, *see* Huntington’s disease
 head and neck squamous cell carcinoma (HNSCC) 93, 263
 heart diseases 300
 heat-fixed cells 155
 heat map, DNA array 40
 HeliScope sequencer 47–49

- helix distortion 74
 helper DNA 260
 hemagglutination assay 140
 hematological malignancies 114–121, *see also* leukemia
 hematopoiesis 31
 hematopoietic stem cell transplantation (HSCT) 283, 293–295, 302
 – bioethics 354
 hematopoietic stem cells, *see* HSCs
 hemoglobin 13, 69
 – pathologic polymerization 312
 – pathological cellular processes 2
 – sickle-cell anemia 167, 168
 α -hemolysin 50
 hemophilia 65, 75, 251, 252, 272
 hemorrhagic fever viruses 150, 311, 323
 hepatitis B core antigen (HBcAg) 130, 137
 hepatitis B surface antigen (HBsAg) 130, 255, 344
 hepatitis B virus (HBV) 96, 97, 130
 – vaccines 137, 255, 344
 hepatitis C virus (HCV) 96, 97
 – antiviral therapies 149
 – miRNAs 329
 hepatocellular carcinoma 96–99
 – signaling pathways 99
 HEPLISAVTM 344
 HER (human epidermal receptor), family 91
 – breast cancer 88
 – HER2 95
 – HER2 targeted therapy 91, 92, 224, 243, 314
 Herceptin, *see* trastuzumab
 hereditary, *see also* inheritance
 hereditary colorectal cancers 101–103
 hereditary leiomyomatosis and renal cell cancer (HLRCC) 108
 hereditary non-polyposis colorectal cancer (HNPCC) 102, 103
 herpesvirus thymidine kinase 146, 273
 Herzyme 314
 hESC (human ESCs) 280–282, 296–302
 – bioethics 350–352
 – clinical trials 296–302
 heterochromatin 6
 heteroplasmy 77
 heterozygous carriers 62, 68–70
 – genetic testing 200, 204
HEXA gene 71
 hexosaminidase A 71
HFE (*High for Fe*) gene 198
 HGH (human growth hormone) 230
 HGP 174–176, 179
 hierarchical shotgun approach 175
 HIF (hypoxia-inducible factor) 105, 273
 High Five cells 235
High for Fe (*HFE*) gene 198
 high-throughput screening (HTS) 3
 high-throughput sequencing (HTS) 45
 highly active antiretroviral therapy (HAART) 148
 hinge region 35
 Hippel–Lindau syndrome, *see* von Hippel–Lindau syndrome
 histones 5, 19–21
 – histone acetyltransferases (HATs) 21
 – histone deacetylase 288
 – modification 19–21
 HIV 34, 124, 127–130, 153
 – antiviral therapies 145–148
 – dependency factors 322
 – gene therapy 273
 – lentiviral vectors 324
 – ribozyme drugs 314, 315
 – RNAi 324
 – structural proteomics 194
 – vaccines 139
 HLRCC (hereditary leiomyomatosis and renal cell cancer) 108
 HMG-CoA-reductase 66
 HNPCC (hereditary non-polyposis colorectal cancer) 102, 103
 HNSCC (head and neck squamous cell carcinoma) 93, 263
 Hodgkin, Thomas 114
 Hoechst stains 57
 homeostasis, hormones 27
Homo (genus), family tree 180
 homoplasm 77
 homozygous carriers 64, 70
 – genetic testing 201
 Hooke, Robert 57
 hormones 27, 28
 – androgens 111, 112
 – human growth hormone (HGH) 230
 – hormonal therapeutic strategies 112
 – recombinant protein drugs 245–247
 – somatostatin 233
 host organisms, recombinant gene expression 232, 233
 host tropism 127
 – HPV 138
 housekeeping genes 43
HOXB13 109
HPC1 109
 HPP (Human Proteome Project) 189
 HPV, *see* human papillomavirus
 HSCs 31, 262
 – adult 283
 HSCT, *see* hematopoietic stem cell transplantation
 HTS, *see* high-throughput screening/sequencing
 human accelerated region 1 (HAR1) 178
 human cells, *see* cells
 human epidermal receptor, *see* HER
 human ESCs, *see* hESCs
 human factor V 44
 human genome 174–188
 – composition 178
 – functional elements 187
 – human genome project, *see* HGP

- human growth hormone (HGH) 230
 human immunodeficiency virus, *see* HIV
 human life, beginning of 350
 Human Longevity Inc. 186
 human-on-a-chip 53, 54
 human organisms, chimeric 280
 human papillomavirus (HPV) 137, 138
 – recombinant vaccines 137, 138, 255
 Human Proteome Project (HPP) 189
 human skin cells, type-switching 290
 human tissue-type plasminogen activator (tPA) 235, 252, 253
 humanized mAbs 242
 Humira 243
 humoral immunity 34–36
 hunger, chronic feeling of 64
 Huntington's disease (HD) 64, 68, 69
 – bioethics 348, 353
 – genetic testing 199, 348, 353
 – stem cell differentiation 292, 293
 hybridization, comparative genomic 205–207
 – direct 39
 – exome sequencing 184, 185
 hydrolysis, ATP 11
 hypercoagulability disorder 44
 hypermutation 36
 hyperplasia, neointimal 342
 hypersensitivity to drugs 226
 hypertrophic cardiomyopathy (HCM) 210, 211
 hypophosphatemia 62
 hypoxia-inducible factor (HIF) 105, 273
- i*
- ICAT (isotope-coded affinity tagging) 193
 Ice Bucket Challenge 298
 icosahedral viruses 124
 identification, target 3, 4
 IEF (isoelectric focusing) 189, 190
 IFNs (interferons) 98, 143, 149, 250, 251
 IGS (internal guide sequence) 312
 IKMC (International Knockout Mouse Consortium) 181
 imago, swallowtail 189
 Imatinib 216
 immobilized antibodies, ELISA 141
 immortality, replicative 87
 immune checkpoint inhibition 96
 immune system 30–36
 – adaptive 33–36
 – cells 32
 – cellular immunity 33–34
 – humoral immunity 34–36
 – immunologic adjuvants 137
 – innate immunity 30–33
 immunoglobulins 33, 35, 239
 – class switching 35
 immunostimulatory oligonucleotides 342–344
 immunotherapy, cell-based 114, 133
 – gene-based 272, 273
- Imperative of Responsibility 347
 imprinting, genomic 21, 62–64
 IMs (intermediate metabolizers) 220, 221
in vitro fertilization (IVF), bioethics 345, 346, 351–354
 – genetic testing 201
 – hESCs 280, 281
 – three-person 80
in vitro gene expression 233
in vivo gene therapy 259
 inactivation, 6-mercaptopurine 222
 – conditional 55
 – by methylation 63
 – viruses 134–137
 – X-chromosome 21, 22, 74
 inclusion bodies 234
 indirect ELISA 140
 individual genomes 182
 individual pharmacotherapy 226, 227
 induced mutations 13
 induced pluripotent stem cells, *see* iPSCs
 infantile Tay–Sachs disease 71
 infectious diseases 2, 30, 123–168
 – AIDS, *see* AIDS, HIV
 – bacteria 153–166
 – bioethics 349
 – eradication 135
 – eukaryotic pathogens 166–168
 – gene therapy 271–273
 – malaria 69, 166–168
 – opportunistic pathogens 154
 – plague, cholera und tuberculosis 156–158
 – prions 151
 – secondary infections 128
 – viruses 123–150
 inflammatory diseases 273
 – chronic 80–82
 – decoy oligonucleotides 342, 343
 – recombinant protein drugs 243, 244, 250
 influenza viruses 130–132
 – antiviral therapies 149
 – vaccines 137
 inheritance, genetic disorders 61
 – haplotype blocks 183
 – Mendelian 62
 – *see also* hereditary
 inhibitors, AS ONs 305
 – dSMADi 291, 292
 – histone deacetylase 288
 – JAK/STAT pathway 290, 291
 – β -lactamase 165
 – miRNA 329, 330
 – neuraminidase 150
 – PARP 92, 93
 – polymerases 144
 – proteases 145
 – reverse transcriptase 142–146, 149
 – tyrosine kinase inhibitors (TKIs) 91–94

- Iniparib 92
initiation, initiator caspases 9
– transcription 15, 16
– translation 22–24, 164, 326, 327
innate immune system 30–33
insect cells, *in vitro* expression of foreign genes 235
insertions 14
– chromosome abnormality 203
insulin, biosynthesis 246
– diabetes mellitus 81, 246
– endogenous 245, 246
– molecular cloning technologies 230
– recombinant 245–247
insurance companies, genetic testing 349
integrated therapeutic genes 258
intercalating agents 13, 14, 24
intercellular communication 26
interference, RNA, *see* RNA interference
interferons (IFNs) 98, 143, 149, 250, 251
intergenic DNA 178
intermediate metabolizers (IMs) 220, 221
internal guide sequence (IGS) 312
International HapMap Project 182–184
International Knockout Mouse Consortium (IKMC) 181
interphase 8, 9
intrinsic pathway, apoptosis 9, 10
– blood coagulation 251
introns 17, 18, 305, 306, 310
– human genome 177
– PCR 42
inversions 203
inverted terminal repeats (ITRs) 262–265
iPSCs 286–289
– bioethics 352
– differentiation to pancreatic β -cells 300
– directed differentiation 291–294
– medical usage 296–302
islets of Langerhans 81
isoelectric focusing (IEF) 189, 190
isotope-coded affinity tagging (ICAT) 193
isotype switching 35
ivacaftor 71
IVF, *see in vitro* fertilization
- j**
Jaenisch, Rudolf 300
JAK/STAT pathway 290, 291
Jenner, Edward Anthony 132
Jolie, Angelina 199
Jonas, Hans 347, 348
“junk” DNA 174, 177, 186
juvenile Tay–Sachs disease 71
- k**
Kalydeco 71
Kant, Immanuel 347
karyotypes 115–117, 201–205
- CML patients 116
– conventional karyotyping 203
– SKY 206
Kaufman, Matthew 279
Kearns–Sayre syndrome (KSS) 78
kidneys, aptamers 339
– chronic kidney disease 231, 247
– embryonic kidney cells 139, 235
– polycystic kidney disease (PKD) 65, 67
– tumors 105
Kirsten rat sarcoma, *see* KRAS
knockin/knockout genes 52, 54, 55
– IKMC 181
Köhler, Georges 241
Kozak sequence 24
KRAS 94–96, 224
– RNAi 323
Kringle domains 253
KynamroTM 310
- l**
label-free detection 59
labelled target 38
 β -lactam antibiotics 162, 163, 165
 β -lactamase inhibitors 165
Langerhans islets 81
latency, clinical 127, 128
LDLs (low-density lipoproteins) 65, 66
Leber’s congenital amaurosis (LCA) 271, 272
Leber’s hereditary optic neuropathy (LHON) 78, 79
Leigh syndrome (LS) 78, 79
lentiviral vectors 262, 275
– shRNA delivery 320–322
– tissue specificity 270
lentiviruses, *see* HIV
Lesch–Nyhan syndrome 298
leukemia 114–121, 293–296
– ALL, *see* acute lymphoblastic leukemia
– chromosomal translocation 202, 203
– CML, *see* chronic myelogenous leukemia
– HSCT 293–295
– myelogenous 115
– SNPs 121
leukocytes 31
library generation 47, 335
lifestyle–genotype interaction, diabetes mellitus 82
lineages, adult stem cells 283
– therapeutically relevant 292
lipids, cationic 320
lipopeptides, bacterial 343
lipopolysaccharides (LPS) 159, 343
liposomes 137, 266
– gene transfer 259
– siRNA delivery 320–324
liquid-phase hybridization 184, 185
live vaccines 133–136
liver, hepatocellular carcinoma 96–99, *see also* hepatitis . . .

- locked nucleic acids (LNA) 307–309, 329
 long-acting β -adrenoceptor agonists (LABAs) 80
 long QT syndrome (LQTS) 299
 long-terminal repeat (LTR) 129, 261
 low-density lipoproteins (LDLs) 65, 66
 LS (Leigh syndrome) 78, 79
 lumen 7
 luminal A tumors 88, 89
 lung cancer 93–96
 lymph node, hematological malignancies 114
 lymphocytes 31
 lymphoma 115, 116
 Lynch syndrome 102, 103
 Lyon, Mary 21, 74
 Lyonization 21, 74
 lysis, complement system 33
 – oncolytic viruses 263, 264
 – virus life cycle 126
 lysosomes 4, 5, 8
 – lysosomal protein degradation 25
- m**
- M-FISH (multiplex FISH) 205, 206
 mAbs, *see* monoclonal antibodies
 MAC (membrane attack complex) 33
 MacugenTM 334, 339–341
 macular degeneration, age-related 244, 245, 301, 302, 322, 334, 339–341
 mad cow disease 151
 maintenance methylation 20
 major histocompatibility complex (MHC) 31–35, 107
 – ADRs 226
 – vaccination 133, 137
 malaria 69, 166–168
 male patients, *see* men
 malignant cells 9, 30
 – tumors 85–88
 – stem cells 293–295
 – *see also* cancer
 mammalian cells, *in vitro* expression of foreign genes 235, 236
 – RNAi 319
 MammaPrint assay 89, 212
 mammary stem cells 284
 mantle cell lymphoma (MCL) 116–118
 MAP (MUTYH-associated polyposis) 103
 mapping, genome 172, 173
 maraviroc 148
 Marfan's syndrome 64, 67, 68
 marker genes, prognostic 40
 Martin, Gail 279
 mass spectrometry, proteins 190–193
 matrix-assisted laser desorption/ionization (MALDI) 190, 191
 maturity onset diabetes of the young (MODY) 82–83
 MBL-associated serine proteases (MASPs) 32
 MCL (mantle cell lymphoma) 116–118
 MDR (multidrug resistant), gene 218
 – pathogens 164–166
 MDS (myelodysplastic syndromes) 120
 measles 135
 meat production, stem cell burgers 296, 297
 medical genetic tests 197–214
 – bioethics 348–350
 medicine, molecular, *see* molecular medicine
 – personalized 187
 melting curve analysis 44
 membranes, membrane attack complex 33
 – mitochondria 6
 – nuclear 4
 men, prostate cancer 109–114
 – X-linked disorders, *see* X-linked disorders
 Mendelian inheritance 62
 mercaptopurine, pharmacogenetic tests 216, 222
 MERRF syndrome 78
 mesenchymal stromal cells, *see* MSCs
 messenger RNA, *see* mRNA
 MET 95, 107
 metabolic labeling 192
 metabolism, bacteria 160
 – drugs 218–222
 – phenylalanine 72
 metamorphosis, swallowtail 189
 metaphase 8, 9
 metastases 40, 86, 110, 111, 114, 212, 213
 – pharmacogenomics 216
 metazoa 153, 154
 2'-O-methoxyethyl-RNA (MOE) phosphorothioate 307, 309, 329
 2'-O-methyl-RNA (OMe) phosphorothioate 307, 337
 methylation, CpG dinucleotides 20
 – gene inactivation 63
 – status in iPSCs 289
 7-methylguanosine 17
 methyltransferases 18–21, 118
 – TPMT 216, 221, 222
 mfold algorithm 306
 MHC, *see* major histocompatibility complex
 mice, *see* mouse models
 microarrays, AmpliChipTM CYP450 222
 – DNA, *see* DNA microarrays
 – leukemic cells 121
 microinjection, pronuclear 54, 55, 236
 microRNAs, *see* miRNAs
 microsatellite instability (MSI) 100–104
 microscopy, fluorescence 56–58
 Miller syndrome 184
 Milstein, César 241
 Milwaukee penguins 311
 minicircle DNA vectors 267
 mipomersen 310
 MIQE 43
 miRNAs (microRNAs) 325–330
 – artificial 318

- circulating 329
 - generation of iPSCs 288
 - miRNA-loaded RISC 326, 327
 - nomenclature 327
 - posttranscriptional targeting 269
 - and siRNAs 326
 - in tumors 328
 - mismatch repair abnormalities 100
 - Mitalipov, Shoukhrat 282
 - mitochondria 4–7
 - DNA, *see* mtDNA
 - mitochondrialopathies 77–80
 - RNAP 14
 - stained 57
 - mitosis 8, 9
 - MLPA (multiplex ligation-dependent probe amplification) 209
 - MMR vaccine 135
 - modified nucleotides 307, 308, 337
 - MODY (maturity onset diabetes of the young) 82, 83
 - MOE (2'-O-methoxyethyl-RNA) phosphorothioate 307, 309, 329
 - molecular beacon probes 45
 - molecular biology, central dogma 10
 - molecular cloning technologies 230
 - molecular diagnosis 207–213
 - molecular markers, colorectal cancer 103–105
 - molecular medicine, animal models 51–56
 - basics 1–4
 - ethics 345–354
 - methods 37–60
 - molecular oncology 85–122
 - molecular profiling, breast cancer 89
 - molecular virology 123–152
 - molecules, self-splicing 311
 - Molly 237
 - monkeys, animal models 52
 - monoclonal antibodies (mAbs), generation 241
 - hepatocellular carcinoma signaling pathways 99
 - intracellular penetration 106
 - nanobodies 244
 - recombinant protein drugs 239–245
 - therapeutic 240, 243–245
 - monogenic diseases 62–80
 - bioethics 353
 - gene therapy 271, 272, 276
 - monooxygenases, CYP 219
 - Montagnier, Luc 127
 - morality, *see* bioethics
 - morphine 220
 - mosquitoes, *Anopheles* 167
 - mouse models 52, 298
 - knockin/knockout 54, 55
 - mRNA 16–18
 - anti-mRNA strategies 304, 305
 - decay 327
 - mutated 313
 - transcription 14, 16
 - MSCs 279, 284
 - cartilage formation 295, 296
 - MSI (microsatellite instability) 100–104
 - mtDNA 7
 - mutation 77–80
 - mTOR, mTOR/PI3K pathway 90
 - VEGF-mTOR pathway 106
 - mucolipidosis II 8
 - Mullis, Kary B. 41, 42
 - multicellular organisms, somatic cells 13
 - multidrug resistance (MDR), gene 218
 - pathogens 164–166
 - multifactorial diseases 80–83, 276
 - Parkinson's disease 298
 - multiple drug combinations 142
 - multiplex FISH (M-FISH) 205, 206
 - multiplex ligation-dependent probe amplification (MLPA) 209
 - multipotent stem cells 278, 279
 - mumps 135
 - muscle growth, gene doping 269
 - muscular dystrophy, BMD, *see* Becker muscular dystrophy
 - DMD, *see* Duchenne muscular dystrophy
 - mutations 13, 14
 - antibody hypermutation 36
 - *APC* 102
 - *BRCA1* 199
 - CFTR channel 70
 - “driver” 93
 - drug targets 223
 - EGFR 93
 - environmental factors 14
 - exon-skipping strategy 310
 - genetic disorders 63
 - germline carriers 103
 - influenza viruses 131
 - mRNA 313
 - mtDNA 77
 - oncogenes 87
 - private 213
 - *RAS* 104, 105
 - multiplex PCR 142
 - MUTYH-associated polyposis (MAP) 103
 - mycobacterial ATP synthase 158
 - Mycobacterium bovis* 160
 - Mycobacterium tuberculosis* 153, 154, 157
 - myelodysplastic syndromes (MDS) 120
 - myelogenous leukemia 115, 116
 - Myriad Genetics 199
- n**
- N*-acetyl-p-benzoquinone imine (NAPQI) 222, 223
 - nanobodies 244
 - nanoparticles, CALAA-01 325
 - transferrin carrying 266
 - nanopore sequencing 47, 51

- National Center for Biotechnology Information (NCBI) 181
 Nazi Germany 345
 NCBI (National Center for Biotechnology Information) 181
 Neanderthal Genome Project 179, 180
 necrotic cells 9
 neointimal hyperplasia 342
 neovascularization, choroidal 339
 NER (nucleotide excision repair) system 73, 74
 nested PCR 141
 neural stem cells 284
 neuraminidase inhibitors 150
 neurodegenerative diseases, genetic disorders 68, 69
 – Huntington's disease, *see* Huntington's disease
 – Parkinson's disease, *see* Parkinson's disease
 – stem cell therapies 284, 290–293, 296–300
 neurons, cholinergic 27
 – dopaminergic, *see* dopaminergic neurons
 – synapses 26
 neuropeptides 26
 neurotransmitters 26, 27
 neutral mutations 13
 neutral protamine Hagedorn (NPH) 247
 “never smoker” lung cancers 93
 nevirapine 144
 new molecular entity (NME) 3
 newborn screening 200
 next-generation sequencing (NGS) 45–51, 182–184, 210, 211
 – bioethics 349, 350
 – Neanderthal Genome Project 179
 – Venter, Craig 186
 nilotinib 216
 nivolumab 107
NKX3.1 110
 no-template control (NTC) 43
 nomenclature, antibodies 243
 – miRNAs 327
 non-Hodgkin lymphoma (NHL) 115, 116
 non-small cell lung cancer (NSCLC) 93–96
 nonfunctional protein products 14, 310
 noninherited genetic disorders 61
 nonliving vaccines, bacterial 160
 – viral 133–139
 nonviral delivery, siRNAs 320, 321
 nonviral gene transfer 266, 267
 Northern blot 38–40, 306, 328
 NPH (neutral protamine Hagedorn) 247
 nuclear envelope 5
 nuclear membrane 4
 nucleocapsid 125
 nucleolytic degradation 307, 314, 337
 nucleosides 18, 19, 142–146, 343
 – DNA viruses 149, 150
 – nucleoside analog reverse-transcriptase inhibitor (NRTI) 142–146, 226
 – second-generation analogs 142
 nucleotides, modified 18, 19, 307, 308, 337
 – NER system 73, 74
 – reversible terminator 49
 nucleus 4–6
- o**
- oblimersen 310
 off-target effects 107, 319
 Okazaki fragments 11
 oligodendrocyte precursor cells (OPCs) 292, 293
 oligonucleotides, antisense (AS ONs), *see* antisense oligonucleotides
 – aptamers 333–344
 – decoy 342–344
 – immunostimulatory 342–344
 – siRNAs 316–326, 329, 330
 oligopotent stem cells 278, 279
 oncogenes 87
 – sporadic prostate cancer 111–114
 oncology, molecular, *see* molecular oncology
 – oncogenesis “driver” mutations 93
 – oncolytic viruses 263, 264
 – paradigm shift 2
 – Personal Genome Project 186
 oncolytic viruses 263, 264
 oncomiRs 328
 oncoretroviral vectors 260–262
 Oncotype DX® test 99, 213
 Online Mendelian Inheritance in Man (OMIM) 64
 opportunistic pathogens 154
 opsins 75
 opsonization 136
 Optaflu 137
 oral bioavailability 2, 143
 oral polio vaccine (OPV) 134, 135
 Orbitrap mass analyzer 193
 organelles 77
 – human cells 4–8
 organic anion transporting polypeptides (OATP) 217
 organic cation transport (OCT) proteins 217
 organs, artificial 53, 54
Orthomyxoviridae 130
 orthopoxviruses 150
Orthoretrovirinae 260
 oseltamivir 149, 150
 OSKM factors 286, 288
 overexpressing, genes 52
 oxaliplatin-based adjuvant therapy 104
 oxazolidinones 166
- p**
- p53* 87, 110, 263, 272
 P-glycoprotein (PGP) 218
 packaging signal (Ψ) 262, 263
 PAH (phenylalanine hydroxylase) 72, 73
 pairing, Watson–Crick 303–306
 palivizumab 243
 pan-drug resistance (PDR) 166
 pancreas, β -cells 300

- pandemics 124
 – influenza 130, 131
 – pathogenic bacteria 155–157
 – vaccination 137, 344
- panitumumab 216
- papillary RCC 106, 108
- paracetamol, metabolism 223
- paracrine hormones 28
- paradigm shift, individual pharmacotherapy 226
 – oncology 2
- parallelization, sequencing 46
- parasites 153, 154
- Parkinson's disease, dopaminergic neurons 27
 – fibroblast transdifferentiation 290
 – gene therapy 273
 – stem cell therapies 300, 301
- PARP (poly-ADP ribose polymerase) inhibitors 92, 93
- passenger strand 317
- pathogen-associated molecular patterns (PAMPs) 30
- pathogens 30
 – bacteria, *see* bacteria
 – eukaryotic 153, 154, 166
 – multidrug resistant 164–166
 – opportunistic 154
 – prions 124, 151
 – viruses, *see* viruses
- pathological cellular processes 2
- patient-derived xenograft (PDX) 93
- patient-specific ESCs 282
- Pauling, Linus 2
- PCR 40, 41
 – bacterial detection 160
 – fragments sequencing 210
 – molecular diagnosis 207–209
 – quantitative 40–45
 – virus detection 139–142
- pDC (plasmacytoid dendritic cells) 344
- PDEs (phosphodiesterases) 30
- PDR (pan-drug resistance) 166
- pegaptanib 339–341
- PEGylation, aptamers 339
 – proteins and peptides 231
- penguins of Milwaukee 311
- Penicillin G 162
- Penicillium notatum* 161
- pentavalent vaccines 138
- pentose phosphate pathway 8
- PEptide transporters (PEPTs) 217
- peptides, enfuvirtide 147, 148
 – GLP-1 247
 – insulin 245–247
 – PEGylation 231
 – peptide hormones 27
 – vaccines 134
- peptidoglycan 155
- peptidyltransferase activity 311, 312
- peroxisomes 4, 5, 8
- Personal Genome Project 184–186
- personalized medicine 2
 – computer models 187
- pertuzumab 91, 92
- PGD (preimplantation genetic diagnosis), *see* preimplantation genetic diagnosis
- "PGP-10" 185
- PGx, *see* pharmacogenetics
- phage display technology 242, 243
- phagocytosis 32
- pharmacodynamic properties 217
- pharmacogenetic testing 216
 – privacy issues 227
- pharmacogenetics 215–227
- pharmacokinetics 217
 – PEG-coupled aptamers 339
- phenotype 13, 14
 – CpG island methylator phenotype (CIMP) 101
 – ethnic background 219
 – genetic disorders 62–65, 68, 69, 78, 79
 – genetic testing 210–212
 – loss-of-function 54
 – proteome 188, 189
 – resistant 142
 – stem cells 298
- phenylalanine 72
- phenylalanine hydroxylase (PAH) 72, 73
- Phenylketonuria (PKU) 72, 73
- Philadelphia chromosome 115, 117, 118, 205
- philosophy, ethics, *see* bioethics
- phosphatidylinositol-3-kinase (PI3K) 89–96
- phosphodiesterases (PDEs) 30
- phosphoinositide (PI) pathway 30
- phosphorodiamidate morpholino oligomers (PMO) 307, 308
 – DMD therapies 310
- phosphorothioates 307, 308
- phosphorylation, proteins 28
- photoreceptors, retinal 75
- PIC (preinitiation complex) 15
- Pichia pastoris* 235
- plague 156, 157
- plants, cell cultures 238
 – plantibodies 238
 – transgenic 236–238
- plasmacytoid dendritic cells (pDC) 344
- plasmids 171, 230
 – nonviral gene transfer 266
 – replication deficient viruses 260
- Plasmodium falciparum* 153, 167
- plasmons, SPR 59
- pleiotropy 64
- pleuromutilin antibiotics 166
- pluripotent stem cells 277–282
 – bioethics 350–352
 – biomedical research 296–299
 – *see also* iPSCs
- PMs (poor metabolizers) 220, 221

- point mutations 13
 poliovirus 134, 135, 140
 Polly 237
 poly-ADP ribose polymerase (PARP) inhibitors 92, 93
 polyadenylation 17
 polycystic kidney disease (PKD) 67
 polyethylene glycol (PEG)-coupled, aptamers 339
 – liposomes 329
 – recombinant proteins 230, 231
 polygenic disorders 80–83
 polyketides 163
 polymerases, DNA 11, 12
 – inhibitors 144
 – polymerase chain reaction, *see* PCR
 – RNA 14, 15
 polymorphisms, drug targeting 222
 – RFLPs 172, 203, 207
 – SNPs, *see* SNPs
 polypeptide antibiotics 164
 polyposis 100–103, 323
 polyribosomes 23
 poor metabolizers (PMs) 220, 221
 pore formation, complement system 33
 Post, Mark 297
 postmitotic cells 283
 postexposure prophylaxis 132
 postnatal genetic tests 198–200
 postsynaptic neuron 26
 posttranscriptional gene silencing (PTGS) 315
 posttranscriptional regulation, miRNAs 325
 posttranscriptional targeting 269
 posttranslational modification 7, 24
 posttranslational processing 24
 “power plants”, cellular 6
 PPi (pyrophosphate) 48
 Prader–Willi syndrome (PWS) 21, 62–64
 – genetic testing 202, 206
 – genomic imprinting 62
 pre-miRNAs 326
 preclinical testing 3, 4
 predictive test, genetic 199
 – bioethics 348–350
 predispositional testing 199–200
 – bioethics 349
 preimplantation genetic diagnosis (PGD) 72, 198–201
 – bioethics 201, 345–347, 352–354
 – hESCs 298
 – sex ratio shift 354
 preinitiation complex (PIC) 15
 prenatal genetic tests 200–202
 preproinsulin 246
 presymptomatic tests 199
 presynaptic neuron 26
 pri-miRNAs 326
 primers, annealing 41, 44
 – extension reaction 39
 – walking 173, 174
 prions 124, 151
 privacy issues, pharmacogenetic testing 227, *see also* bioethics
 private mutations 213
 Prochymal 295
 prodrugs, cancer gene therapy 272, 273
 profiling, gene expression 38
 – molecular 89
 prognostic marker genes 40
 proinsulin 246
 prokaryotes, *see* bacteria
 Prontosil 160
 pronuclear microinjection 54, 55, 236
 proof-reading, DNA replication 12
 prophase 8, 9
 prophylaxis, postexposure 132
 proproteins 24
 prostate cancer 109–114
 protanopia 75
 proteases, inhibitors 145–147
 proteasomes 25
 proteins, annexins 111
 – ApoE 199, 200
 – biosynthesis 23, 24
 – degradation 25, 26
 – DNA replication 10
 – EML4-ALK 94
 – fusion proteins 249, 250
 – glycosylation 7, 24, 25
 – interaction with DNA 6
 – lysates 190
 – mass spectrometry 190–193
 – nonfunctional products 14
 – PEGylation 230, 231
 – phosphorylation/dephosphorylation 28
 – posttranslational modification 7, 24
 – prions 151
 – protein-coding genes 176
 – recombinant protein drugs 229–256
 – vaccines 134, 136, 254, 255
 proteolytic maturation, HIV 129, 130, 147
 proteomics 188–195
 proto-oncogenes 87
 – lung cancer 95
 protozoa 22, 34
 – parasites 153, 154, 166
 – *Tetrahymena thermophila* 311
 Provence 114, 133
 Prusiner, Stanley B. 151
 pseudotyping 270
 pseudouridine 18
 Ψ (packaging signal) 262, 263
PTEN 328
 PTGS (posttranscriptional gene silencing) 315
 Pulmozyme 255
 purification, affinity 193
 PWS, *see* Prader–Willi syndrome
Pyrococcus furiosus 42

pyrophosphate (PPi) 48
pyrosequencing 47, 48

q

qualification, target 3
quantification, relative 43
quantitative fluorescence PCR (QF-PCR) 209
quantitative PCR (qPCR) 40–45
– molecular diagnosis 207
quantitative proteomics 192–194
quinolones 163

r

Ramakrishnan, Venkatraman 23
ramucirumab 107
RAS, mutations 30, 104
rats, animal models 52
– DRG 308
– α -tropomyosin 18
Rawls, John 347
Rb (retinoblastoma) gene 110, 111
real-time PCR 141
receptor-mediated endocytosis 66
receptor tyrosine kinase (RTK) 30, 95
recessive genetic disorders 61, 62, 69–77
recognition processes 22
recombinant protein drugs 229–256
– host organisms 232, 233
recombinant vaccines 134, 136, 254, 255
recombinant viruses 134–136, 139
recycling system, cellular 8
red-green color blindness 75
relative quantification 43
release factor eRF1 24
renal cell carcinoma (RCC) 105–109
repetitive elements, genome 177
Replagal 255
replication, DNA 10–26
replication deficient viral vectors 259, 260
replicative immortality 87
RepoxygenTM 268
reproductive cloning of humans 281
– bioethics 346–348, 351
reprogramming, direct 289–291
– somatic cells 286, 287
RER (rough endoplasmic reticulum) 4, 7
resistance, against antibiotics 164–166
– castration-resistant prostate cancer (CRPC) 112–114
– endocrine therapy 90
– pan-drug resistance (PDR) 166
respiratory chain, genetic defects 79
respiratory syncytial virus, *see* RSV
Responsibility, Imperative of 347
restriction fragment length polymorphisms (RFLPs) 172
– genetic testing 203, 207
RET 95
retinal photoreceptors 75

retinoblastoma (Rb) gene 110, 111
retrotransposons 178
retroviral vectors 260–262
– iPSC generation 286
retroviruses 10, 125
– HIV, *see* HIV
Rett syndrome 62
reuptake pump 26
reverse transcriptase 128, 129
– inhibitors 145
reverse transcription, two-color microarrays 39
reverse-transcription PCR (RT-PCR) 42
reversible terminator nucleotide 49
ribonucleic acid, *see* RNA
ribonucleoproteins 12
ribosomal ribonucleic acid (rRNA) 18, 19
ribosomes 5, 6
– prokaryotic 163
– translation 23
riboswitches 334, 335
ribozymes 304, 311–315
– delivery 314
rifamycin 163
“right to know”/“right not to know” 347–350
rimantadine 149
risk-adapted therapies 120
risk assessment, DNA microarray-based 213
RNA 4
– anti-mRNA strategies 304, 305
– aptamers 335
– DNA replication 10
– double-stranded 315–320, 327
– expression scatter plot 40
– mRNA, *see* mRNA
– miRNA, *see* miRNA
– secondary structure 306
– sequencing 51
– shRNA, *see* short hairpin RNA
– siRNAs, *see* siRNAs
– stability in biological fluids 337
– transcription 14–19
– viral 124, 125, 329
RNA-dependent RNA polymerase (RdRP) 131
RNA-induced silencing complex (RISC) 304, 305, 316–318, 326, 327
RNA interference (RNAi) 181, 304, 305, 315–325
– and AN ONs 317
RNA polymerase (RNAP) 14–16
– RNA-dependent RNA polymerase (RdRP) 131
RNA viruses 125, 126
RNA world hypothesis 312
ROS1 95
Rotterdam 76 gene signature 89
rough endoplasmic reticulum (RER) 4, 7
rRNA 18, 19
RSV 144, 145, 323, 324
– recombinant protein drugs 240, 243

- RT-PCR (reverse-transcription PCR) 42
 RTK (receptor tyrosine kinase) 30, 95
 Rubella 134, 135, 140
- s**
S. pneumonia 158
 Sabin vaccine 136
 sabutamol 80
Saccharomyces cerevisiae, genome sequencing 170
 – *in vitro* expression of foreign genes 234
 Salk vaccine 136
 Sanger, Frederick 45
 sarcomatoid RCC 109
 savior sibling 347
 SBS (sequencing by synthesis) 47
 scanning, translation 24
 scatter plot, RNA expression 40
 scFv (single-chain variable fragment) antibodies 240, 244
 schistosomiasis 168
Schizosaccharomyces pombe 235
 SCID (severe combined immunodeficiency), enzyme replacement therapy 231
 – gene therapy 271, 272
 – HSCs 295
 SCNT, *see* somatic cell nuclear transfer
 screening, HTS, *see* high-throughput screening 3
 – newborn 200
 SDS-PAGE 189, 190
 second-generation, antisense oligonucleotides (AS ONs) 30
 – nucleoside analogs 142
 – sequencing 46–49
 secondary infections, AIDS 128
 secondary structure, aptamers 337
 – RNA 306, 313
 SELEX procedure 335–339
 self-complementary AAV (scAAV) vectors 264
 self-splicing molecules 311
 semiconductor sequencing 47–49
 semiconservative replication 11
 septic shock 159
 sequence tagged site (STS) mapping 173
 sequencing, disease-targeted 210
 – exome 184, 185, 211, 212
 – molecular diagnosis 209–212
 – next-generation, *see* NGS
 – parallelization 46
 – PCR fragments 210
 – pyrosequencing 47, 48
 – RNA 51
 – SBS (sequencing by synthesis) 47
 – second generation 46–49
 – shotgun 174
 – SOLiD 47–50
 – third-generation 46, 47, 49–51
 – whole genomes 170–174
 SER (smooth endoplasmic reticulum) 7
 serotonin 26
- severe combined immunodeficiency, *see* SCID
 severe genetic disorders, definition 353
 sex ratio shift 354
 SHARP trial 98
 sheep, transgenic 236, 237
 Shimomura, Osamu 58
 shock, septic 159
 short-acting β-adrenoceptor agonists (SABAs) 80
 short hairpin RNA (shRNA) 301, 318, 319
 – viral delivery 322
 short interfering RNAs, *see* siRNAs
 shotgun proteomics 192–194
 shotgun sequencing 174
 sialic acid 150
 SIB (Swiss Institute of Bioinformatics) 189
 sildenafil, *see* Viagra
 signal recognition particle (SRP) 25
 signal transduction 28–30
 signaling pathways, breast cancer 89–92
 – hepatocellular carcinoma 99
 SILAC (stable isotope-labeled amino acids in cell culture) 192
 silencing, miRNAs 327
 – PTGS 315
 – RISC, *see* RISC
 silent mutations 13
 Singer, Peter A. D. 346
 single-chain variable fragment (scFv) antibodies 240, 244
 single-gene disorders 62–80
 single-molecule real-time (SMRT) sequencing 47–50
 single-nucleotide polymorphisms, SNPs, *see* SNPs
 single-strand breaks (SSBs) 92
 sipuleucel-T 114, 133
 siRNAs 316–326, 329, 330
 – aptamers 339–342
 – bifunctional 320
 – clinical trials 322–325
 – design 317
 – endogenous 316
 – hair removal 324
 – and miRNAs 326
 – off-target effects 319
 skin, cell type-switching 290
 – engineered constructs 53
 SKY (spectral karyotyping) 205, 206
 SLC3OA8 82
 “Sleeping Beauty” transposon system 267, 268
 small interfering RNAs, *see* siRNAs
 small molecular drugs 3, 181
 smallpox 132
 – antiviral therapies 150
 Smithies, Oliver 54
 smokers, lung cancer 93
 smooth endoplasmic reticulum (SER) 7
 SMRT (single-molecule real-time) sequencing 47–50
 SNPs, asthma 80
 – DNA microarrays 212

- genome mapping 172
 - International HapMap Project 183
 - leukemic cells 121
 - mutated mRNA correction 313
 - sofosbuvir 149
 - solid-phase hybridization 184, 185
 - SOLiD (sequencing by oligo ligation detection) 47–50
 - somatic cell nuclear transfer (SCNT) 20, 237
 - bioethics 351, 352
 - therapeutic cloning 281, 282, 351, 352
 - transgenic animals 236–238
 - somatic cells 13
 - reprogramming 286, 287
 - somatic cell gene therapy 258, 259
 - somatic recombination 36
 - somatostatin 233
 - Sonic Hedgehog pathway 109
 - sorafenib 97, 98
 - sorting, fluorescence-activated 58, 59
 - proteins 7
 - Southern blot 118, 203, 208
 - Sovaldi 149
 - “Spanish flu” 131
 - specificity, aptamers 339
 - drugs 303
 - gene transfer 270
 - siRNAs 319, 320
 - spectral karyotyping (SKY) 205, 206
 - sphingolipid storage disease 71, 72
 - spiegelmers 337, 338, 340, 341
 - spindle poles 9
 - spirillum shape 155
 - spliceosomes 17
 - splicing 16, 17
 - alternative 18
 - AS ONs 76, 305, 306, 310
 - self-splicing molecules 311
 - Spodoptera frugiperda* 235
 - spontaneous mutations 13
 - sporadic prostate cancer 110, 111
 - SPR (surface plasmon resonance) 59
 - Spumavirinae 260
 - SRC family 111
 - SRP (signal recognition particle) 25
 - SSBs (single-strand breaks) 92
 - stabilization, aptamers 337
 - antisense oligonucleotides (AS ONs) 306–308
 - HIF 108
 - stable isotope-labeled amino acids in cell culture (SILAC) 192
 - stains, double-stranded DNA-binding dyes 44
 - Giesma 203, 204
 - Gram 155
 - Hoechst 57
 - Staphylococcus aureus* toxin 50
 - STAT 97, 98
 - Steitz, Thomas 23
 - stem cells 277–302
 - adult 282–286
 - bioethics 350–352
 - burgers 296, 297
 - combinations with gene therapy 301
 - differentiation 291–293
 - division modes 283
 - embryonic, *see* ESCs
 - hematopoietic, *see* HSCs
 - induced pluripotent, *see* iPSCs
 - mammary 284
 - medical applications 293–302
 - neural 284
 - stereochemistry, aptamers 333, 337, 338
 - spiegelmers 333, 337, 338
 - warfarin 225
 - steroid hormones 27
 - steroidogenesis 113
 - strands, DNA 11, 92
 - RNA 124–126, 315–320, 327
 - Streptomyces* 161
 - streptomycin 163
 - stromal cells, *see* MSCs
 - structural chromosome abnormalities 203
 - structural proteomics 194
 - STS (sequence tagged site) mapping 173
 - subunit vaccines 137, 138, 255
 - subbactam 165
 - sulfonamides 163, 166
 - superoxide dismutase (SOD)* gene 298
 - surface plasmon resonance (SPR) 59
 - surface proteins, influenza viruses 130, 131
 - surplus embryos 280, 351, 352
 - susceptibility testing 199, 200
 - swallowtail, metamorphosis 189
 - swine flu 131
 - Swiss Institute of Bioinformatics (SIB) 189
 - symbionts, bacteria 155
 - symmetric stem cell division 283
 - Synagis 243
 - synapses, chemical 26
 - synonyms, genetic code 22
 - Szostak, Jack W. 336
- t**
- T-cell receptor (TCR) 33
 - TALENs (transcription activator-like effector nucleases) 274, 275
 - Tamiflu 149, 150
 - tamoxifen 90
 - metabolism 221
 - TaqMan probes 45
 - targeted delivery, siRNAs 320, 321, 342
 - targeted genome editing 274, 275
 - targeted therapeutics 119, 120
 - targeting, antibiotics 162
 - drugs 3, 4, 222–226
 - dual 91, 92

- labelled 38
- posttranscriptional 269
- siRNAs 320, 321, 342
- transductional 270
- TATA box 14, 15
- Tay–Sachs disease 71, 72
- telomerase reverse transcriptase (TERT) 12, 13
- telomerases 12, 13, 269, 309
- telomeres 5, 6, 12, 13
 - genome sequencing 171, 172, 178
 - aging 237
 - Dolly 237
- telophase 8, 9
- teratoma formation 279, 280, 287–289, 296, 299
- testing, alternatives to animal testing 52–54
 - Ames test 14
 - antiviral susceptibility 142
 - DNA microarrays 212
 - genetic, *see* genetic testing
 - Guthrie test 73
 - pharmacogenetic, *see* pharmacogenetic testing
 - preclinical 3, 4
- testosterone 27, 28, 112, 113
- tetanus toxin 159
- tetracycline 56, 163
- tetracycline response element (TRE) 56
- Tetrahymena thermophila* 311
- theophylline 336
- therapies, ACT 168
 - adult stem cell 293–296
 - anti-EGFR 104
 - antiviral 142–150
 - cell-based immunotherapy 114, 133
 - combination 148
 - endocrine therapy resistance 90
 - enzyme replacement 271
 - gene-based immunotherapy 272, 273
 - gene therapy 257–276
 - HAART 148
 - hematopoietic stem cell transplantation 293, 295
 - HER2 targeted 91, 92, 224, 243, 314
 - hormonal therapeutic strategies 112
 - oxaliplatin-based adjuvant 104
 - risk-adapted 120
 - RNAi 323
 - stem cell 299–302
 - targeted therapeutics 119, 120
 - therapeutic cloning 281, 282, 351, 352
 - therapeutic enzymes 254, 255
 - therapeutic window 216, 217, *see also* diseases, drugs
- Thermus aquaticus* 42
- thiopurine-S-methyltransferase (TPMT) 216, 221, 222
- third-generation, antisense oligonucleotides (AS ONs)
 - 307–309
 - sequencing 46, 47, 49–51
- thrombocytes 31
- thrombolytics 251–254
- tissue specificity, gene transfer and expression 267–270
- tissue-type plasminogen activator (tPA), human 235, 252, 253
- TKIs (tyrosine kinase inhibitors) 91–94
- TLR (toll-like receptor) 319, 320, 323, 343
- TNBCs (triple negative breast cancers) 88, 89
- toll-like receptor (TLR) 319, 320, 323, 343
- tooth, bioengineered 296
 - wisdom 284
- totipotent cells 278, 279
- Tour de France, gene doping 268
- toxicity, drugs 217, 226
- toxins, bacterial 158–159
- toxoids 160
- transcription 14–19
 - reverse, *see* reverse transcription
 - transcriptional targeting 269, 270
- transcription factors 16
 - E2F 342, 343
 - ESCs 280
- transdifferentiation 289–291
 - fibroblasts 289, 290
- transduction, signal, *see* signal transduction
- transduction efficiency, AAV vectors 264
 - “gene gun” 266
 - retroviral vectors 261
- transductional targeting 270
- transesterification, splicing 17
- transferrin 266, 325
- transgenic animals and plants 54, 236–238
- translation 21–24
- translational repression 327
- translocation 203
- translocon 25
- transmembrane glycoproteins, HIV 129
- transmission, viral 127
- transport, drugs 217, 218
- transposon system, “Sleeping Beauty” 267, 268
- trastuzumab, breast cancer 91, 224, 240, 243
 - emtansine 91, 92, 240, 245
 - pharmacogenetic tests 216, 224
- TRE (tetracycline response element) 56
- trials, clinical, *see* clinical trials
- Trichoplusia ni* 235
- trimethoprim 166
- trinucleotide repeats, *see* triplet repeats
- triple negative breast cancers (TNBCs) 88, 89
- triplet repeats, fragile X syndrome 208, 209
 - Huntington’s disease (HD) 68
- trisomy, genetic testing 200–204
- tRNA (transfer RNA) 18, 19
 - nucleotidyltransferase 19
- tropism 127
 - AAV vectors 265
 - HPV 138
- α -tropomyosin, rat 18
- Tsien, Roger 58
- tuberculosis 157, 158

- tumor suppressor genes 87
 – *APC* 101, 102
 – *p53*, *see p53*
 – *PTEN* 96, 99, 328
 – replacement 272, 273
 – sporadic prostate cancer 110, 111
 tumor suppressor miRNAs 328
 tumors, breast 88–93
 – colon 99–105
 – kidneys 105
 – luminal A 88, 89
 – lung 96–99
 – miRNAs 328
 – prostate 109–114
 – renal cell carcinoma (RCC) 105–109
 – teratoma formation, *see* teratoma formation
 – tumor viruses 127
 two-color microarrays 39
 two-dimensional gel electrophoresis 189–192
 two-hit hypothesis 87
 tyrosine 72
 tyrosine kinase inhibitors (TKIs) 91–94
- u**
UBE3A gene 63
 ubiquitin 25
 UNAfold package 306
 Universal Declaration on the Human Genome and Human Rights 349
 unwinding 11, 15
 uptake, antisense oligonucleotides (AS ONs) 308
 – drugs 217, 218
 – siRNAs 320
 utilitarianism 346
- v**
 vaccines 132–139, 160
 – bacterial 160
 – DNA 139, 266
 – HIV 139
 – inactivated 136, 137
 – live 133–136
 – protein and peptide 134
 – recombinant 137, 138, 254, 255
 – subunit 137, 138, 254, 255
 – viruses 132–139
 valproic acid 288
 vampire bat 253, 254
 variola virus 133
 – antiviral therapies 150
 vascular endothelial growth factor (VEGF) 92, 244, 273, 322, 323, 339–241
 – renal cell carcinoma (RCC) 105–107
 – VEGF–mTOR pathway 106
 vCJD (new variant Creutzfeldt–Jakob disease) 151
 vectors, adenoviral 262–264, 321
 – adeno-associated virus (AAV) 264, 265, 321
 – cloning 170–172
 – gene therapy 257–276
 – gutless 263
 – lentiviral 262, 271, 324
 – minicircle DNA 267
 – most suitable 275
 – retroviral 260–262, 271
 Velaglucerase-alpha 254
 vemurafenib, pharmacogenetic tests 216
 Venter, J. Craig 176
 – Human Longevity Inc. 186
 – individual genome 182
 vesicles, secretory 7
 – synaptic 26
 vessels, angiogenesis 87, 88, 244, 245, 322, 323, 339–341
 VHL (von Hippel–Lindau syndrome) 105
 ViagraTM 30
Vibrio cholerae 157
 viral vector delivery, genes, *see* gene therapy
 – shRNA 322
 viral RNAs 124, 125, 329
 viral transmission 127
 viruses 123–152
 – attenuated 134
 – cytomegalovirus 309, 310
 – detection 139–142
 – Ebola 150, 323
 – HBV 96, 97, 130, 137, 255, 323
 – HCV 96, 97, 149, 329
 – hemorrhagic fever 150
 – HIV 34, 127–130, 145–148, 322–324
 – inactivated 134–137
 – influenza 130–132, 136, 137, 149
 – molecular virology 123–152
 – newly emerging 124
 – oncolytic 263, 264
 – papilloma 138, 255
 – polio 134–136
 – recombinant 134–136
 – replication deficient 259
 – retroviruses, *see* retroviruses
 – RSV, *see* RSV
 – vectors, *see* vectors
 – virus-like particles (VLP) 137
 – West Nile Virus 310, 311
 vitamin K epoxide reductase (VKOR) 225
 VitrandeneTM 308
 VKOR (vitamin K epoxide reductase) 225
 Vogelstein model 99, 100
 von Hippel–Lindau syndrome (VHL) 105
 Vorinostat 21
 VPRIV 254
- w**
 Waddington, Conrad H. 19
 Waksman, Selman 161

- warfarin, metabolism 225
 – pharmacogenetic tests 216
 waste disposal, cellular 8
 Watson–Crick pairing 303–306
 Watson, James 11
 – individual genome 182
 West Nile Virus 310, 311
 Western blot 140, 306
 Whole exome sequencing (WES) 170–188, 201, 211, 212
 whole genome sequencing (WGS) 184, 185, 201, 211, 212
 – bioethics 349, 353, 354
 Wilkins, Marc 188
 Wilmut, Ian 237
 wisdom tooth, stem cells 284
 women, breast cancer 88–93
 – HLRCC 108
 – imprinting 21, 62–64
 – mitochondrial DNA 77, 80
 – single-gene disorders 62–64
 worms 153, 154, 168
- x**
 X-chromosome inactivation 21, 74
 X-linked disorders 62, 64
 – recessive 74–77
- y**
 X-ray crystallography 194
 X-SCID 271
 xenobiotics, removal from cell 218
 xenograft, patient-derived 93
 xeroderma pigmentosum (XP) 73, 74
 Xp11.2 translocation-associated RCC 109
- z**
 Y-linked disorders 62, 64
Yersinia pestis 156
 Yamanaka factors, *see* OSKM factors
 yeasts 153, 154, 166
 – baker's, *see* *Saccharomyces cerevisiae*
 – *in vitro* expression of foreign genes 234, 235
 – yeast artificial chromosomes (YAC) 171, 172
 Yonath, Ada 23
- z**
 zanamivir 150
 zeromode waveguide (ZMW) 50
 Zidovudine 145
 zinc finger nucleases (ZFNs) 274, 275
 Zolinza 21
 zygote 278
 zymogens 24

