# Index

- **A**

A-site (acceptor site), 150  
acceptor arm, 148  
accessory chromosome, 70  
achondroplasia, 191  
Acquired Immunodeficiency Syndrome (AIDS), 210  
adaptations, 262  
addition rule of probability, 46  
adene, 87–91, 190, 347  
adenoias, 217  
adenoins triphosphate (ATP), 88  
adenoiviruses, 240  
admixtures, 275  
affectec pedigree, 176  
aging  
clones and, 306–307  
DNA, 307  
genetics of, 334–335  
agrobacterium, 289  
AIDS (Acquired Immunodeficiency Syndrome), 210  
alkylating agents, 194  
allele frequencies, 252–253  
alleles. See also genes  
codominance and, 52–53  
complications with, 54–56  
crossing over of, 34  
dominance and, 51–54  
finding unknown, 45  
incomplete dominance and, 52  
incomplete penetrance and, 53–54  
interacting, 56–57  
lethal, 56  
masking, 58–59  
multiple, 54–55  
overview, 25–26, 39, 252, 347  
relating to genotypes, 255–256  
segregating, 43–44  
alligators, 344  
alpha-globin chains, 156  
alernative splicing, 142  

*Alu* elements, 142  
amino acids. See also polypeptides  
connecting with tRNA, 133  
defined, 347  
as member of translation team, 147  
in polypeptide chains, 144  
role in translation, 148–149  
tRNA and, 133  
aminoacyl-tRNA synthetases, 149  
amniocentesis, 185  
amplification, 211  
anabolic steroids, 165  
anaphase, 30, 347  
aneploidy, 222–224, 227, 232, 347  
anogiosis, 207  
animals. See also specific animals  
cloning, 300–303  
domestication of, 284  
providing biological evidence, 269  
transgenic experiments with, 294–296  
arnealing, 271  
anthrax, 338–339  
antibiotic resistance, 337  
antibodies, 309  
nticipation  
Fragile X syndrome and, 232  
overview, 64, 347  
strand slippage and, 191–192  
anticodon, 148, 347  
antigens, 53  
ntiparallel, 91, 347  
apomixis, 226  
apoptosis, 212, 347  
apurination, 192  
Arber, Werner (scientist), 330  
aromtase enzyme, 74  
aftificial twinning, 303–304  
Ashkenazi, 200  
ATP (adenosine triphosphate), 88  
Auerbach, Charlotte (scientist), 193, 196  
ausism, 232, 234, 321  
automated DNA sequencing, 127  
autosomal chromosomes, 23  
autosomal dominant traits, 177–178
autosomal recessive traits, 178–180, 199
autosome, 347
Avery, Oswald (scientist), 95

• B •

backcross, 347
bacteria, 20–21, 286, 297–298
bacterial DNA, 94
bacteriophage, 95, 244, 347
Barr bodies, 75
basal lamina, 206
base, 347
base analogs, 193–194
base-excision repair of DNA, 198
Bateson, William (geneticist), 327
Beadle, George (scientist), 153
benign growths, 204–205
beta-globin chains, 156
biochemists, role in gene therapy, 241
biodiversity, 251–252, 258
Bioinformatics For Dummies (Claverie & Notredame), 336
biological determinism, 315
biological evidence, 268–274
biological species concept, 262
bioterrorism, 338–339
bipolar disorder, 236
bipotential gonad, 69
birds, 72–73, 260–261
birth defects. See specific birth defects
blastocyst, 301
blood type, 53
boundary elements, 162
breast cancer, 53, 207, 210, 215–216
brewer’s yeast, 120–121
Bridges, Calvin (college student), 223, 225

• C •
cacogenics, 314
caMV (cauliflower mosaic virus), 289
cancer
anabolic steroids and, 165
benign, 204–205
breast, 53, 207, 210, 215–216
cell cycle, 208–213
chromosome abnormalities, 213–214
colon, 217
as DNA disease, 207–214
hereditary, 214–217
lung, 218
malignant, 205–206
metastasis, 206–207
mouth, 218–219
overview, 203–204, 207–208
preventable, 217–219
probability of developing, 204
prostate, 215
proto-oncogenes and, 209
relationship with viruses, 210
skin, 219
tumor-suppressor genes and, 209, 211–213
cap, adding to mRNA, 140–141
captive breeding, 258
carcinogens, 193
carcinomas, 206, 217
careers, 15–18
carriers, 175, 230–231
carriers, 175, 230–231
cats, color determination, 75
cauliflower mosaic virus (caMV), 289
cDNA library, 243–245
cell cycle
chromosomes, 22–26
defined, 26, 347
eukaryotes, 19, 21–22
example of, 26
interphase of, 27–28
meiosis, 30–35
mitosis, 26–30
prokaryotes, 19–21
relationship with cancer, 208–213
replication in, 101
role of cell biologists in gene therapy, 241
types of organisms, 19–20
cell division, 208. See also meiosis; mitosis
cell-lines, 318
cell lysis, 270
cell wall, 20–21
cells
with nucleus, 21–22
regulating death of, 212–213
sex, 22
somatic, 22
with versus without nucleus, 19–20
without nucleus, 20–21
Central Dogma of Genetics, 153
centromeres, 24, 347
Index

CF (Cystic Fibrosis), 179–180, 199–200
chain-reaction sequencing, 329
chaperones, 155
Chargaff, Erwin (scientist), 91, 96, 328
Chase, Alfred (scientist), 95
to many, 228–231
circular DNA, 115–116
CJD (Cruetzfeldt-Jakob disease), 170
classical genetics. See Mendelian genetics
classifying species, 262–263
Claverie, Jean-Michel (author), Bioinformatics For Dummies, 336
Clonaid, 302
cloning
animals, 300–303
arguments for/against, 310–312
creating clones, 303–306
defined, 299
DNA, 299–300
Dolly the sheep, 300, 302–308
evironment affecting, 310
faster aging and, 306–307
LOS and, 308
problems, 306–310
screening, 244
with somatic cell nucleus, 304–306
technology of, 299–300
totipotency and, 300
twinning process and, 303–304
CODIS (COmbined DNA Index System), 270, 276
codominance, 52–53, 347
codons, 145–146, 347
college professors, career of, 17
Collins, Francis (scientist), 332
colon cancer, 217
complementary pairing, 348
complete penetrance, 53
complex phenotypes, 144
complications
with alleles, 54–56
gene interaction, 56–57
genes in hiding, 58–59
genes linked together, 59–62
genes with multiple phenotypes, 62
consanguineous relationships, 180, 348
consensus sequences, 135
conservative replication, 101
totipotency and, 300
twinning process and, 303–304
control elements. See transposable elements (TEs)
Correns, Carl (botanist), 327

Philadelphia, 214
in prokaryotes, 21

Chloroplasts, 21
Chloroplast DNA (cpDNA), 94–95
Chromatids, 28, 30, 34–36, 347
Chromatin-remodeling complexes, 161
Chromosomal rearrangements, 233–236
Chromosome arms, 222
Chromosome disorders
aneuploidy, 222–224, 227
counting chromosomes, 222–227
duplications, 233–234
Fragile X syndrome, 232
mosaicism, 232, 294
overview, 221–222
polyplody, 225, 231
trisomy, 227–231
variations in chromosomes, 227–236
chromosome walking, 246
Chromosomes. See also X chromosomes;
Y chromosomes
abnormalities of, 213–214
accessory, 70
anatomy of, 23–26
counting/pairing, 222–227
extra/missing, 223–224, 227–228
in gametes, 34–35
genome size and, 117–119
louse, 343
meiosis and, 30–35
mitosis and, 26–30
mules, 226
nondisjunction of, 74
overview, 22–26, 347

Chemotherapy, 206
Chickens, 122
Chimeras (DNA), 343
Chloroplast DNA (cpDNA), 94–95
Chromosomal rearrangements, 233–236
Chromosome disorders
aneuploidy, 222–224, 227
counting chromosomes, 222–227
duplications, 233–234
Fragile X syndrome, 232
mosaicism, 232, 294
overview, 221–222
polyplody, 225, 231
trisomy, 227–231
variations in chromosomes, 227–236
chromosome walking, 246
Chromosomes. See also X chromosomes;
Y chromosomes
abnormalities of, 213–214
accessory, 70
anatomy of, 23–26
counting/pairing, 222–227
extra/missing, 223–224, 227–228
in gametes, 34–35
genome size and, 117–119
louse, 343
meiosis and, 30–35
mitosis and, 26–30
mules, 226
nondisjunction of, 74
overview, 22–26, 347

Chemotherapy, 206
Chickens, 122
Chimeras (DNA), 343
Chloroplast DNA (cpDNA), 94–95
Chromosomal rearrangements, 233–236
Chromosome disorders
aneuploidy, 222–224, 227
counting chromosomes, 222–227
duplications, 233–234
Fragile X syndrome, 232
mosaicism, 232, 294
overview, 221–222
polyplody, 225, 231
trisomy, 227–231
variations in chromosomes, 227–236
chromosome walking, 246
Chromosomes. See also X chromosomes;
Y chromosomes
abnormalities of, 213–214
accessory, 70
anatomy of, 23–26
counting/pairing, 222–227
eXtra/missing, 223-224, 227-228
in gametes, 34-35
genome size and, 117-119
louse, 343
meiosis and, 30-35
mitosis and, 26-30
mules, 226
nondisjunction of, 74
overview, 22-26, 347
counseling, genetic, 173–186
cpDNA. See chloroplast DNA (cpDNA)
Creighton, Harriet (scientist), 328–329
Crick, Francis (scientist), 97, 100, 153
Cri-du-chat syndrome, 234–235
crime scene investigation, 268–274
crossing-over, 19, 60, 348. See also recombination
Cruetzfeldt-Jakob disease (CJD), 170
current issues
aging genes, 334–335
bioinformatics, 336
bioterrorism, 338–339
DNA bar coding, 339
 evolution of antibiotic resistance, 337
gene chips, 336–337
 genetics of infectious disease, 338
personalized medicine, 333
proteomics, 335
stem cell research, 334
CVS (chorionic villus sampling), 185
cyclins, 27
Cystic Fibrosis (CF), 179–180, 199–200
cytokinesis, 30, 348
cytoplasm, 21
cytosine, 87–91, 190, 348

Darwin, Charles (The Origin of Species), 261, 263, 325–326
Davenport, Charles (father of American eugenics movement), 314
ddNTPs (di-deoxyribonucleoside triphosphate), 125, 348
deamination, 192–193, 348
degeneracy theory, 314
degenerate
 combinations, 145–146
 overview, 143–144, 241, 348
 reading frame, 146
 universality of genetic code, 146–147
degradation of DNA, 269
deletion, 188, 233–235, 348
delivery systems, 238–240
denaturation, 158, 270–271, 348
deoxyribonucleic acid. See DNA (deoxyribonucleic acid)
deoxyribonucleoside triphosphates. See dNTPs (deoxyribonucleoside triphosphates)
deoxyribose, 88
depurination, 348
designer babies, 315–316
developmental genetics, 331–332
di-deoxyribonucleoside triphosphate (ddNTPs), 125, 348
dihybrid cross, 48–50, 348
dimers, 195
dioecy, 68
dioxins, 164
diploid, 23, 253, 275, 348
direct repair of DNA, 198
disasters, identifying victims of, 281–282
D-loop replication, 116
DNA bar coding, 339
DNA chimeras, 343
DNA (deoxyribonucleic acid)
 aging, 307
 bacterial versus mitochondrial, 94
cancer as disease of, 207–214
chemical components of, 84–93, 86–89
chloroplast, 94–95
circular replication of, 115–116
cloning, 299–300
compared with RNA, 130
as component of DNA sequencing, 125
copying. See replication
decomposing, 269
deoconstrucing, 84–93
degradation of, 269
durability of, 86
extraction, 85, 270–274
history of, 95–97
junk, 266–268
mitochondrial, 93–94
molecular genetics and, 10–12
nitrogen-rich bases in, 87
nuclear, 93
overview, 83–84, 348
packaging of, 160–161
of plants and animals, 268
repair options, 198
repetitive sequences of, 119
role of ribose sugar in, 130
strands, transcription and, 135–136
structure of, 89–93
on telomeres, 24
transcription of, 134
varieties of, 93–95
viruses, 84
DNA fingerprinting
constructing, 272–274
defined, 265
invention of, 331
junk DNA and, 266–268
matching, 275–276
paternity testing, 277–279
relatedness testing, 280–282
reviewing old crimes with, 277
using in criminal cases, 274–277
DNA library, 243–245
DNA polymerase, 107, 110, 111, 190
DNA profiling. See DNA fingerprinting
DNA sequencing
automated, 127
of brewer’s yeast, 215–216
categories of, 119
of chickens, 122
components of, 125–126
discovery of, 329
of humans, 122–124
milestones in, 120
palindrome, 244–245
process, 117–127
of roundworms, 121–122
DNA synthesis, 104
DNA template, 113, 161
DNase I enzyme, 161
dNTPs (deoxyribonucleoside triphosphates), 105, 125, 348
Dolly the sheep (clone), 300, 306
dominance
codominance, 52–53
defined, 42, 348
establishing, 41–43
incomplete, 52–54
simple, 51
dominant epistasis, 58
dominant traits, 177–178, 182–183
donor, 304
dosage compensation, 74
double helix. See DNA (deoxyribonucleic acid)
Down syndrome, 228–230
Down Syndrome Cell Adhesion Molecule (DSCAM), 166–167
drugs, correcting reactions to, 333
duplication, 233–234
durability of DNA, 86
dysplasia, 205
 ectoderm, 301
Edward syndrome (trisomy 18), 231
electrophoresis, 126, 273
elongation, 139, 151
embryos, 69, 303–304
endoderm, 301
enhanceosome, 162
enhancer genes, 137, 161–162
enucleation, 304
environment
Down syndrome, 230
effect on phenotypes, 65
effects on cloning, 310
overview, 65
enzymes
overview, 103, 106–107, 132
replication and, 106–107, 136
restriction, 244–245, 330
epigenetics, 63, 348
epistasis, 58, 348
equilibrium, 254
establishing dominance, 41–43
ethics
designer babies, 315–316
eugenics, 314–315
 genetic property rights, 320–321
informed consent, 316–320
overview, 313
preimplantation genetic diagnosis and, 316
privacy issues, 319–320
euchromatin, 123, 242
eugenics, 314–315
eukaryotes
 chromosomes, 21–22
example of, 20
gene control in, 161–164
introns and, 139
nuclei and, 84–85
overview, 19, 21–22, 103, 129, 268, 348
eukaryotes (continued)
  replication in, 112–115
  termination factor in, 139–140
euploidy, 223, 225–227, 348
exons
  defined, 139, 348
  editing of, 139, 141–142
  of genes, 166
exonucleases, 111–112, 269
expressivity, 54, 178, 348
extension stage of PCR process, 272

* F *

familial Down syndrome, 230
family tree
  autosomal dominant traits, 177–178
  autosomal recessive traits, 178–180
  genetic disorders, 180
  overview, 174–177
  pedigree analysis symbols, 175
  proven with DNA, 277–282
  X-linked dominant traits, 182–183
  X-linked recessive traits, 180–182
  Y-linked traits, 183–184
fetal hemoglobin, 158
fingerprinting evidence, 272–274
Fire, Andrew (geneticist), 166
fish, 73, 295–296
FISH (fluorescent in situ hybridization), 245
Fisher, Ronald A. (geneticist), 59
fitness, 262
flagella, 21
flu, genetics of, 338
fluorescent in situ hybridization (FISH), 245
Fly Room, 225
food safety issues, 291–292
forensic genetics
  collecting biological evidence, 269
  constructing DNA fingerprints, 272–274
  defined, 265
  extracting DNA from evidence, 270–274
  family relationships, 277–282
  junk DNA, 266–268
  matching DNA, 275–276
  population genetics and, 12
  reviewing old crimes, 276–277
  using DNA, 274–277
  fragile sites, 232
Fragile X syndrome, 232
Franklin, Rosalind (scientist), 96–97
free radicals, 194
frequency of mutations, 189
Frye standard, 273
functional change mutations, 197

* G *
gain-of-function mutation, 197
galactosemia, 186
galls, 289
Galton, Francis (scientist), 314
gametes, 34, 349
gangliosides, 200
Gap 2 phase, 28
gastrula, 301
Gelsinger, Jesse (gene therapy case), 247, 318
gene chips, 336–337
gene expression
  anabolic steroids, 165
dioxins, 164
DNA packaging and, 160–161
genes managing transcription, 159–165
hormones and, 164
induction, 158
modifying protein shapes and, 155–156
overview, 12, 157–159
protein complications, 170
retroactive control of, 165–168
RNAi (RNA interference), 166
tissue-specific nature of, 157
transcriptional control of, 159–165
translation and, 168–169
translation of mRNA into amino acids, 168–169
gene flow, 258, 260–261
gene gun, 289–290
gene mapping
  HapMap Project, 259–260
  overview, 246, 258–259
  paternity testing, 277–279
  relatedness testing, 280–282
  social lives of animals, 260–261
gene-patenting, 320–321
gene pool, 252
gene therapy
  alleviating genetic disease, 237–238
  creating DNA libraries and, 243–245
defined, 237, 330
delivery system design, 238–240
gene mapping, 240–246
progress in, 247–248
using viruses with, 238–240
genes. See also alleles
aging, 334–335
breast cancer, 216
colon cancer, 217
controlling, 161–164
defined, 9, 24, 84, 349
effect of mother’s love on, 343–344
enhancers, 161–162
exons of, 166
in hiding, 58–59
homeotic, 332
insulators, 162
interacting, 56–57
introns of, 166
jumping, 328–329
linked, 59–62
locating for transcription, 134–135
locations of, 240–243
lung cancer, 218
managing transcription, 159–165
with multiple phenotypes, 62
naming, 42
oncogenes, 209–211
pain perception, 344
period, 158
prostate cancer, 215
proto-oncogenes, 209
regulatory agents, 161–162
segmentation, 331–332
silencers, 162
skin cancer, 219
studying chemistry of, 11–12
transposable elements, 162–164
traveling, 287
tumor-suppressor, 209, 211–213
on X chromosome, 69
on Y chromosome, 70–71
genetic anticipation, 232
genetic code
Central Dogma of Genetics, 153
codons of, 145–146
defined, 143
degenerate, 143–147
features, 144
proteins, 153–156
reading frame, 146
translation, 147–153
universality of, 146–147
genetic counselors
analyzing autosomal traits, 177–180, 199
analyzing X-linked traits, 180–183
analyzing Y-linked dominant traits, 183–184
building and analyzing family trees, 174–177
career of, 17–18
family trees, 174–178
overview, 17–18, 173–174
role in gene therapy, 241
use of probability, 47
genetic disorders, 180, 237–248. See also specific disorders
genetic engineering, 287
Genetic Information Nondiscrimination Act (GINA), 320
genetic modification (GM). See transgenics
genetic privacy issues, 319–320
genetic property rights, 320–321
genetic racism, 314–315
Genetic Savings and Clone, 305
genetic testing
do-it-yourself, 344–345
general, 184–185
informed consent issues and, 316–320
newborn screening, 186
overview, 184
prenatal, 185–186
restrictions on, 317–318
(genetic treatment, safety of, 318–319
(genetic variation, 251–254
(genetics lab, 13–15
(genetics problems, 41, 48–50
Genetics Society of America Web site, 18
(genital ridge, 69
(genomes. See also DNA sequencing
(chicken, 122
defined, 93, 117, 158, 349
(roundworm, 121–122
sequencing, 117
varieties of, 117–119
(yeast, 120–121
(genomic imprinting, 63–64, 308–309, 335
(genotype frequencies, 252–254
genotypes
defined, 39, 100, 129, 143, 266, 349
reconstructing individual, 280–281
relating to alleles, 255–256
germ-cell mutations, 188. See also mutations
Gilbert, Walter (scientist), 329
Gilman, Michelle (author), GRE Test For
Dummies, The, 16
GM (genetic modification). See transgenics
GMO (genetically modified organisms). See
transgenics
graduate students, career of, 15–16
GRE Test For Dummies, The (Vlk, Gilman &
Saydak), 16
Griffith, Frederick (scientist), 95, 327–328
guanine, 349
gyrase, 106, 349

• H •
H1N1 virus, 338
haploid, 23, 349
haplotypes, 259
HapMap Project, 259–260
Hardy, Godfrey (geneticist), 254–257
Hardy-Weinberg law of population
    genetics, 254–257
helicase, 106, 107–108, 349
helix, DNA structure and, 84–93
Hemings, Sally (slave of Thomas Jefferson),
    279, 317
hemizygous, 183
hemoglobin, 158
hemophilia, 77, 181, 189, 234
Henking, Hermann (geneticist), 70
Henry, Edward (police officer), 265
hereditary cancers, 214–217
heritable, 187, 326
Hershey, Chase and Martha (scientists),
    95–96
heterochromatin, 242
heterogametic, 72
heterozygote, 253, 349
heterozygote pedigree, 176
heterozygous, 40, 267
HEXA (hexosaminidase A), 200
hexaploid, 118
HGP. See Human Genome Project (HGP)
histones, 84, 114
history of DNA, 95–97
HIV (Human Immunodeficiency Virus), 210
holoenzyme complex, 161
homeotic genes, 332
homogametic, 72
homologous chromosomes, 23, 349
homozygosity, 40, 176, 267
homozygote, 40, 253, 349
horizontal gene transfer, 287
hormone response elements (HREs), 165
hormones, 164
horses, epistasis in, 58–59
HPV (human papilloma virus), 210
HREs (hormone response elements), 165
Hughes, Walter (scientist), 101, 102
Human Genome Organization Gene
    Nomenclature Committee, 342
Human Genome Project (HGP)
    automated sequencing and, 127
    chicken genome, 122
    open access, 127
    overview, 119–120, 122–124, 332
    role of, 242
    roundworm genome, 121–122
    yeast genome, 120–121
Human Immunodeficiency Virus (HIV), 210
human papilloma virus (HPV), 210
humans
    cloning of, 303
    sex-determination disorders in, 74–77
    sex determination in, 74–77
    sex-influenced traits and, 79
Huntington disease, 56, 177
hybridization, 245
hydrophobic, 92

• I •
immunity to AIDS/HIV, 256
in vitro fertilization process, 315, 316
inbreeding, 257
incomplete dominance, 52
incomplete penetrance, 53–54
independent assortment, law of, 45
indifferent stage, 69
induced mutations, 193–196
infectious disease, genetics of, 338
information access, ethics and, 319–320
informed consent
overview, 316–317
practicing safe genetic treatment, 318–319
privacy, 319–320
restrictions on genetic testing, 317–318
inheritance. See also mode of inheritance
anticipation and, 64
detecting patterns of, 174–178
dominance and, 41–43
intelligence and, 314
of mutation, 189–190
overview, 37, 39–40
probabilities, 46–47
segregation of alleles and, 43–44
sex-linked, 77–80
simple, 40–45
inherited diseases
cystic fibrosis (CF), 199–200
sickle cell anemia, 200
Tay-Sachs disease, 200–201
initiation, 107, 137–138, 148–150
Innocence Project, 276
insects
beneficial, damaged by transgenics, 290–291
discovery of XX-XY sex determination in, 70
sex determination in, 71–72
transgenic, 297
insertion
of bases, 188
defined, 349
mutations, 188
insulator genes, 162
insulin, 329
intelligence, heritability of, 314
intercalating agents, 195
interkinesis, 33
interphase
of cell cycle, 27–28
defined, 27, 349
replication in, 101
introgression, 292
introns, 139, 166, 349
inversion, 233, 234

• J •
J. Craig Venter Institute, 342
Jefferson, Thomas (president), 279, 317
Jeffreys, Alec (DNA fingerprinting inventor), 331
jobs in genetics, 15–18
jumping genes, 328–329
junk DNA, 113, 266–268, 345

• K •
karyotyping, 222
keratin, 122
kinases, 27
kinship, 277
Klinefelter syndrome, 76
Knudson, Alfred (geneticist), 212

• L •
lab technicians, career of, 15
laboratories, 13–15
lagging strands, 110
large offspring syndrome (LOS), 308
law of independent assortment, 45
laws of inheritance, 37
leading strands, 110
lentiviruses, 239–240
lethal alleles, 56
lethal phenotypes, 56
leukemias, 206
ligase, 107, 111, 349
linkage, 59, 349
linkage analysis, 59–62, 241
location-dependent sex determination, 73
loci
chromosome, 25–26
defined, 25, 39, 349
in junk DNA, 267–268
multiple with multiple alleles, 54–55
LOS (large offspring syndrome), 308
loss-of-function mutation, 197
lung cancer, 218
lymphomas, 206
MacLeod, Colin (scientist), 328
mad cow disease, 170
maize, mutations of, 285
malignancies, 204–206
mapping genes, 246, 258–261, 277–282
marcomolecule, 84
Marfan syndrome, 191
marker gene, 289
markers. See loci
McCarty, Maclyn (scientist), 328
McClintock, Barbara (scientist), 163, 328–329
McClung, Clarence (geneticist), 70
medicine, personalized, 333
meiosis
  chromosome activities during, 28–30
  defined, 19, 30, 349
  Down syndrome occurrences and, 228–230
  overview, 30–35
  part I/II, 32–34
  Y chromosome during, 67–68
melanoma, 219
Mello, Craig (scientist), 166
Mendel, Gregor (monk)
  discovering dominant versus recessive traits, 42–43
  finding unknown alleles, 45
  as founder of genetics, 10
  pea plant studies, 38–39
  rediscovery of works by, 326–327
  segregation of alleles and, 43–44
  studying simple inheritance, 40–45
Mendelian genetics, 10–12
mesoderm, 301
messenger RNA. See mRNA (messenger RNA)
metabolism, 27
metaphase, 30, 102, 221, 349
metastasis, 206–207
methionine, 145
methyl groups, 63, 140
microarrays, 336–337
Miescher, Johann Friedrich (medical student), 95
milestones
  development of recombinant DNA technology, 330
  developmental genetics, 331–332
  discovery of jumping genes, 328–329
DNA sequencing, 329
Human Genome Project, 332
invention of DNA fingerprinting, 331
invention of PCR, 329–330
“The Origin of Species” (Darwin), 325–326
rediscovery of Mendel’s work, 326–327
transforming principle, 327–328
mismatch repair of DNA, 112, 198
missense mutations, 197
mitochondria, 21
mitochondrial DNA (mtDNA), 93–94, 282
mitosis, 19, 26–28, 349
MLV (moloney murine leukemia virus), 239
MMTV (mouse mammary tumor virus), 210
mode of inheritance, 174–184
molecular genetics, 10–12
moloney murine leukemia virus (MLV), 239
monoecy, 68
monohybrid crosses, 41, 42, 48
monosomy, 227–228
Monosomy X syndrome, 77
monozygotic, 310
Morgan, Thomas Hunt (scientist), 223, 225
mosaicism, 232, 294
mosquitoes, mutations of, 286
mouse mammary tumor virus (MMTV), 210
mouth cancer, 218–219
mRNA (messenger RNA). See also RNA
  adding cap and tail to, 140–141
  creating DNA libraries and, 243–245
  function of, 131
  harvesting and converting, 243
  lifespan of, 167–168
  post-transcription editing of, 141–142
  silencing, 167
  transcription and, 133
mtDNA (mitochondrial DNA), 93–94, 282
mules, reproducing, 226
Muller, Herman (scientist), 196
Mullis, Kary (PCR studies), 329–330
multiplication rule of probability, 46
mutagen, 193–195
mutations
  autosomal dominant, 178
  breast cancer, 53, 207, 210, 215–216
  cancer and, 206–207
  causes of, 189–196
  chemically induced, 193–195
  chemistry of, 196
chromosomal rearrangements, 233–236
colon cancer, 217
common inherited diseases, 199–201
consequences of, 197
defined, 12, 55, 187
immunity to HIV/AIDS, 210
induced, 193–196
mouth cancer, 218–219
occurring during replication, 191–192
prostate cancer, 215
radiation induced, 195–196
repair of, 198
skin cancer, 219
spontaneous, 189–193
strand slippage and, 191–192
types of, 187–188
unintentional, 286
myeloma, 206

N

Nathans, Dan (scientist), 330
natural selection, 261
Neufeld, Peter (attorney), 276
neutral mutation, 197
newborn screening, 186
no-till farming, 294
non-small cell lung cancers, 218
nondisjunction, 74, 191
nonreciprocal translocation, 235–236
nonsense mutation, 197
Notredame, Cedric (author), Bioinformatics For Dummies, 336
nuclear DNA, 93
nucleosomes, 84, 114
nucleotide-excision repair of DNA, 198
nucleotides
chemical components of, 87
DNA structure and, 89–93
overview, 90, 104–106, 349
nucleus
cells with, 21–22
cells without, 20–21
defined, 19
returning to totipotency, 300–302
nullipotent, 301, 304
nullisomy, 227
Nüsslein-Volhard, Christiane (geneticist), 331–332

O

OH groups, 105, 130
Okazaki fragments, 110
oncogenes, 209–211
oncoretroviruses, 239
one gene–one polypeptide hypothesis, 153
Online Mendelian Inheritance in Man Web site, 18, 62, 246
oocyte, 304
organelles, 21
organic foods, 284
The Origin of Species (Darwin), 325–326
origins, 107
ornithine transcarbamylase (OTC) deficiency, 247
out-crossing, 39

P

p arm of chromosomes, 222
P generation, 349
palindrome DNA sequence, 244–245
paracentric inversion, 234
parthenogenesis, 300
Patau syndrome (trisomy 13), 231
patents, ethics of, 320–321
paternity index, 278
paternity testing, 277–279
PCR. See polymerase chain reaction (PCR)
pea plant studies, 38–39
pedigree analysis symbols, 175
peer review, 292
penetrance
of breast cancer, 53, 216
defined, 79, 349
incomplete, 53–54
reduced, 177–178
sex-limited traits and, 79
Pennsylvania Amish, genetic disorders and, 180
peppers, genes interacting in, 56–57
pericentric inversion, 234
period gene, 158
personalized medicine, 333
PGD (preimplantation genetic diagnosis), 316
phagocytes, 213
pharmaceuticals, 292–293
pharmacogenomics, 333
PHAs (polyhydroxyalkanoates), 298
phenotypes
  alleles and, 39
  anticipation and, 64
  autosomal dominant, 177–178
  autosomal recessive, 178–180
  codominance and, 52–53
  complex, 144
  dominant versus recessive, 42–43
  environmental effects and, 65
  genes with multiple, 62
  genomic imprinting and, 63–64
  incomplete dominance and, 52
  incomplete penetrance and, 53–54
  lethal, 56
  multiple alleles and loci and, 54–55
overview, 25, 51, 93, 100, 129, 143, 266, 349
  sex, 67–68
  sex-influenced, 79
  sex-limited, 79
  studying transmission of, 10–11
  X-linked dominant, 182–183
  X-linked recessive, 180–181
  Y-linked, 80, 183–184
phenylketonuria (PKU), 62, 186
Philadelphia chromosome, 214
phosphates in DNA, 87–89
phosphodiester bond, 90
photosynthesis, 94–95
pipette, 304
PKU (phenylketonuria), 62, 186
plagues, 256
plants
  chloroplasts and, 21
  commercial applications for transgenic, 290–291
  developing transgenic for commercial use, 288–290
  polyploid, 225–226
  providing biological evidence, 268–269
  transgenic, 288–294
plaque, 245
plasma membrane, 20
plasmids, 289
platypus, sex determination in, 341–342
pleiotropic genes, 62
ploidy, 221, 222
point mutation, 188, 282
polar bodies, 35
pollination, 39
poly-A tail, 141
polydactyly, 54
polygynty, 260
polyhydroxyalkanoates (PHAs), 298
polymerase. See DNA polymerase; RNA polymerase; Taq polymerase
polymerase chain reaction (PCR)
discovery of, 329–330
DNA fingerprint, 272–274
genome mapping, 246
overview, 270
process of, 270–272
polymorphism, 267
polynucleotide strand, 90
polypeptide chains, 144
polypeptides. See also amino acids
  complications, 170
  Creutzfeldt-Jakob disease and, 170
  modifying shape, 169
  one gene–one polypeptide hypothesis and, 153
overview, 143–144, 153, 350
radical groups, 153–155
shape of, 155–156
single-stranded-binding (SSB), 107
transcription activator, 161
polyploidy, 225, 231
Poly-X syndrome, 76
population genetics
  allele frequencies, 252–253
  allele-genotype frequencies equilibrium and, 254
  genetic of evolution, 261–264
  genetic variation, 251–254
  genotype frequencies, 253–254
  Hardy-Weinberg law of population genetics, 254–257
  inbreeding and, 257
  mapping gene pool, 258–261
overview, 10, 12, 251
plagues and, 256
  preserving biodiversity, 258
populations, 252
  post-docs, career of, 15–16
Prader-Willi syndrome, 235
precocious puberty, 79
preimplantation genetic diagnosis (PGD), 316
prenatal genetic testing, 185–186, 316
primary structure of proteins, 155–156
primase, 107, 108
primates, transgenics and, 295–296
primers, 108, 125, 271
prion, 170
privacy, information access and, 319–320
probability
  computing inheritance with, 46–47
  of paternity, 278–279
Proband, 174–177
probe, 245
professors (college/university), 17
prokaryotes
  chromosomes in, 21
  defined, 19, 103, 350
  example of, 20
  introns and, 139
  overview, 20–21
  terminator sequences in, 139
promoter, 134–135
promoter sequences, 288
pronuclei, 294
proofreading, replication, 111–112
property rights, 320–321
prophase, 29, 350
prostate cancer, 215
proteins. See polypeptides
proteomics, 335
proto-oncogenes, 209
protonation, 190
P-site (peptidyl site), 150
purine, 87, 350
pyrimidines, 87, 350
quantitative genetics, 10, 13
quaternary structure, of proteins, 156
rabbits, coat color alleles of, 48–50
racism, genetic, 314–315
radiation, 195–196, 285–286
radical groups, 153–155
Rasputin, Gregory (faith healer), 182
rate of mutations, 189
reactive groups, 105, 130
reading frame, 146
recessive, 43, 178–181, 350
recessive epistasis, 58
reciprocal translocation, 235–236
recombinant DNA technology, 242, 330
recombinant offspring, 62
recombination
  defined, 19, 60
  meiosis and, 30–35
  unequal, mutations and, 196
  Y chromosome and, 70–71
reduced penetrance, 177–178
relatedness testing, 280–282
release factors, 151
replication
  circular, 115–116
  conservative, 101
  enzymes and, 136
  in eukaryotes, 112–115
  helix splitting and, 84–93
  mismatches during, 190–191
  overview, 19, 99–103, 350
  process of, 103–112
  semiconservative, 100–101
  spontaneous mutation and, 189–193
  strand slippage, 191–192
  template DNA and, 113
replication fork, 108
repressors, 160
reproductive cloning, 302
reptiles, sex-determination of, 73–74
research scientists, career of, 16–17
resistance
  to antibiotics, 337
  to transgenes effects, 293
restriction enzymes, 244–245, 330
retinoblastoma, 212
retroactive control, of gene expression
  mRNA lifespan, 167–168
  mRNA silencing, 167
  RNA splicing, 166–167
  RNAi (RNA interference), 166
retrotransposons, 163–164
retroviruses, 210
reverse transcription, 243–244
ribonucleic acid. See RNA (ribonucleic acid)
ribonucleotides, 136
ribose, 130–131
ribosomes, 147, 149–150
RNA interference (RNAi), 166
RNA polymerase, 136–137
RNA (ribonucleic acid)
compared to DNA, 130
components of, 129–130
defined, 350
molecular genetics and, 11–12
reading codons and, 145–146
retrotransposons and, 163–164
ribose sugar, 130–131
splicing, 166–167
structure of, 132–133
transcription, 133–140
uracil, 131–132
Robertsonian translocation, 230
rolling circle replication, 116
Romanov family, 182
roundworm genome, 121–122
Rous, Peyton (scientist), 209

S

S phase (Interphase), 28
Sanger, Frederick (geneticist), 329
sarcomas, 206
Saydak, Veronica (author)
GRE Test For Dummies, The, 16
Scheck, Barry (attorney), 276
schizophrenia, 64
SCID (severe combined immunodeficiency), 247
scrapie, 170
screening DNA libraries, 243–245
secondary spermatocytes, 35
secondary structure, 132, 155
segmentation genes, 331–332
segregation, 43–44
selective hybridization, 284
self-pollination, 39
selfing, 39
semiconservative replication, 100–101
senescence (aging), 334
sequence tag site (STS), 246
sequencer, 126
sequencing (DNA)
chicken genome, 122
components for, 125–126
DNA (deoxyribonucleic acid), 117–127
overview, 124–125
results of, 126–127
roundworm genome, 121–122
yeast genome, 120–121
severe combined immunodeficiency (SCID), 247
sex
determination of in birds, 72
determination of in humans, 68–71
determination of in insects, 71–72
determination of in reptiles, 73–74
genomic imprinting and, 63–64
location-dependent determination, 73
overview, 67–68
sex cells, 22
sex chromosomes, 23
sex-determination disorders (humans)
extra X chromosomes, 76
extra Y chromosomes, 76
overview, 74–75
Turner syndrome, 76–77
Sex-determining Region Y (SRY) gene, 71
sex-influenced traits, 79
sex-limited traits, 79
sex-linked inheritance, 77–80
sexual reproduction, 22
short tandem repeats (STRs), 266–268, 331
sickle cell anemia, 200
SIDS (sudden infant death syndrome), 180
signal transduction, 164
silencer genes, 162
silent mutations, 197
simple dominance, 51
simple inheritance, 40–45
single nucleotide polymorphism (SNP) analysis, 246, 282
single-stranded-binding (SSB) proteins, 107
small populations, genetic disorders in, 180
small-cell lung cancers, 218
Smith, Hamilton O. (scientist), 330
Smith, Walter D. (exonerated criminal), 276
SNP (single nucleotide polymorphism) analysis, 246, 282
somatic cells, 22, 304–306
somatic mutations, 187. See also mutations
species, 262–263
Sperling, John (cloning), 305
spermatogonia, 35
spliceosome, 141, 167
splicing, 142, 166–167
spontaneous mutations, 189–193
SSB (single-stranded-binding) proteins, 107
statute of limitations, 276
stem cell research, 334
Stevens, Nettie (scientist), 67
stop codon, 197
strand slippage, 191–192
strands, locating for transcription, 135–136
stress, aging and, 307
STRs (short tandem repeats), 266–268, 331
STS (sequence tag site), 246
Sturtevant, Alfred (college student), 225
substantial equivalence, 291
subunits of ribosomes, 149
sudden infant death syndrome (SIDS), 180
supercoiling, 84, 114
swine flu, 338
synthesized genome, 342

t •
tail, adding to mRNA, 140–141
Taq polymerase, 125, 271–272
TATA box, 135–136
Tatum, Edward (scientist), 153
taxonomic classification, 262
Taylor, J. Herbert (scientist), 101, 102
Tay-Sachs disease, 200–201
telomerase, 107, 113–114, 335
telomeres
  aging and, 307
  aging process and, 335
  cloning problems with, 306–307
  defined, 24, 70, 112, 306, 350
  relationship with eukaryote replication, 113–114
telophase, 30, 350
teosinte, 285
terminator, in transcription, 139–140, 151–152
tertiary structure, 155–156
TEs (transposable elements), 162–164
testcross, 45
testing
  general genetic, 184–185
  newborn screening, 186
  prenatal, 185–186
tetraploid, 231
tetrasomy, 227
therapeutic cloning, 302
Theta replication, 115
thymine, 131–132, 190
tissue-specific, 157
totipotent
cells, 300
cloning experiments and, 300–302
defined, 288, 350
stem cell research and, 334
traits. See phenotypes
transcription
  controlling gene expression and, 159–165
  defined, 129, 133
  elongation phase, 139
  initiation phase, 137–138
  micromanaging, 161–162
  post-transcription processing, 140–142
  preparing for, 134–137
  process of, 134
  reverse, 243–244
  termination of, 139–140
transcription activator proteins, 161
transcription bubble, 138
transcription unit, 134–135
transfer RNA. See tRNA (transfer RNA)
transforming principle, 327–328
transgenes, escaped, 284, 292–293
transgenics
  animal experiments, 294–296
  bacteria experiments, 297–298
  commercial applications for, 290–291
  food safety issues of, 291
  horizontal gene transfer, 287
  insect experiments, 297
  introgression concerns, 292
  no-till farming and, 294
  plants and, 288–294
transition mutation, 188
translation
  defined, 11, 129
  elongation, 151
  familial Down syndrome as a result of, 230
  initiation, 148–151
translation (continued)
modifying, 168–169
of mRNA into amino acids, 168–169
process of, 147
team, 147
termination, 151–152
translocation, 230, 233, 235–236, 328–329
transmission genetics. See Mendelian genetics
transposable elements (TEs), 162–164
transversion mutation, 188
triplet code, 144
triploid, 231
trisomy, 227–231
tRNA (transfer RNA)
connecting with amino acids, 133
elements of, 148–149
as member of translation team, 147
role in translation, 148–149
Tschermak, Erich von (botanist), 327
tumors, 204–206, 210
tumor-suppressor genes, 209, 211–213
Turner syndrome, 76–77
twinning process, 303–304

• U •
ultrasound, 185–186
ultraviolet light, 219
unequal crossing-over, 192
university professors, career of, 17
uracil, 131–132, 350

• V •
variation, Darwin’s principles of, 326
vectors, 238–240, 288
Versuche Pflanzen Hybriden (scientific journal), 326–327
Victoria, Queen of England, 182
viruses, 84, 210, 238–240
Vlk, Suzee (author), GRE Test For Dummies, The, 16
Vries, Hugo de (botanist), 327

• W •
Watson, James (scientist), 97, 100, 123
Weinberg, Wilhelm (geneticist), 254–257
whales, mating habits of, 261
Wieschaus, Erich, 331–332
wild-type, 55
Wilkins, Maurice (scientist), 97
Wilson, Edmund (geneticist), 70
wobble, 145
wobble pairing, 190
wolves, population studies of, 260–261
Woods, Philip (scientist), 101, 102

• X •
X chromosomes, 67–74, 76–78
X inactivation, 74–75
X-linked disorders, 77–78
X-linked dominant traits, 182–183
X-linked recessive traits, 180–181

• Y •
Y chromosomes, 70–71, 76
Y-linked traits, 80, 183–184
yeast genome, 120–121

• Z •
zygotes, 301, 350