Index

A
Abnormal spindlelike microencephaly-associated (ASPM), 119–120
Acinar cell. See Pancreas development
Adipogenesis
adipocyte morphology, 299–300
precursor cells, 298–299
adipose tissue dynamics, 298
cytokine regulation, 307
endocrine control
androgen receptor, 306
estrogen, 306
glucocorticoids, 306–307
insulin, 307
table of hormones, 308
thyroid hormone, 305–306
metabolic disease states, 307–308
model systems, 300–301
negative effectors
GATA, 305
Kruppel-like factors, 305
Pref-1, 305
Wnt, 304–305
positive effectors
AP-1, 301
C/EBP, 302
Kruppel-like factors, 301–302
peroxisome proliferator-activated receptor-γ, 303–304
STAT, 302–303
sterol response element-binding protein-1, 302
prospects for study, 308–309
white adipose tissue versus brown adipose tissue, 299–300
AEC. See Alveolar epithelial cell
AGS3, mitotic spindle orientation control in radial glia cell division, 117–119
Aim, 21–22, 25
α cell. See Pancreas development
Alveolar epithelial cell (AEC), 444
Androgen receptor (AR), adipogenesis regulation, 306
Angiogenesis, sprouting angiogenesis and blood vessel network formation, 320–321
Anterior visceral endoderm (A/E)
dynamics, 189
heterogeneity, 185, 189
overview, 188–189
precursors, 189
signaling, 190–191
specification, 191
translocation control mechanisms, 189–190
AP-1
adipogenesis regulation, 301
osteoblast differentiation regulation, 360
AP-2, eye morphogenesis, 388
Apical membrane, polarity in generation, 98–101
AR. See Androgen receptor
Artery. See Vasculogenesis
Arx, pancreas α-cell development, 463–464
Ascl1. See Mash1
ASPM. See Abnormal spindlelike microencephaly-associated
ATF4, osteoblast differentiation regulation, 358–359
Atoh1, hair cell formation role, 409, 411
Atrioventricular node, 428
Autosomal recessive primary microencephaly (MCPH), 119
A/E. See Anterior visceral endoderm
Axin2, tooth replacement role, 374
B
Basal cell carcinoma (BCC), epidermal stem cells in initiation, 287–289
Basement membrane (BM), epithelial polarization, 101–102
Basolateral membrane, polarity in generation, 98–101
BCC. See Basal cell carcinoma
β cell. See Pancreas development
Blastocyst
cell types and tissues, 186
egg cylinder formation. See Egg cylinder
formation overview, 4–5
lineage specification transcription factors, 168–172
morphogenesis, cell signaling, and lineage allocation relationship in pre-implantation embryo
inner cell mass versus trophectoderm, 172–175
segregation of epiblast and primitive endoderm, 175–176
morphogenetic events in development, 168, 184–185
patterning and cell fate–architecture relationship
asymmetry and readout of patterning, 176–177
proximal–distal axis formation, 176
proximo-distal axis formation and distal visceral endoderm allocation, 177–178
regionalized genetic and signaling activity, 177
prospects for study, 178
Blood vessel. See Vasculogenesis
BM. See Basement membrane
BMP. See Bone morphogenetic protein
Bone. See Skeleton
Bone morphogenetic protein (BMP)
and heart development role, 426
BMP-2 and anterior visceral endoderm signaling, 191
BMP-4
eextraembryonic ectoderm, 187
foregut tube septation, 442
lung development role, 444–445, 449
optical vesicle signaling, 386
chondrocyte differentiation role, 350–351
cross-talk, 70
developmental signaling, 63–64, 66
gastrointestinal system development, 477–478, 480
glial switch role in embryo brain, 269
gradient in cell migration, 142
growth plate development role, 354
Index

Bone morphogenetic protein (BMP) (Continued)
  hair follicle morphogenesis and cycling role, 285
  heart development role, 422–425
  inner ear development, 407
  intestinal cell turnover regulation, 482–483
  kidney development, 496, 498, 500
  lung branching morphogenesis role, 87
  mesenchymal condensation role in skeletal development, 348
  neurogenesis onset and progression in embryo brain, 266–267
  osteoblast differentiation regulation, 357–358
  primordial germ cell specification signaling, 230–231
  regulation of signaling, 69
  somitogenesis role, 334
  tooth development role, 369, 371–373
  vasculogenesis role, 324–325

Boundary formation. See Cell adhesion

Brain
  cranial neural crest cell. See Neural crest cell
  neurogenesis. See Neurogenesis
  progenitor cells in cortex development
    asymmetric division in model systems, 115–117
    classification of cells, 113
    interkinetic nuclear migration, 114
    intermediate progenitors and neuron development, 114–115
    mitotic spindle orientation control in radial glia cell division
      cleavage plane fluctuations, 118–119
      defects and disease, 119–120
      mechanisms, 117–118
    outer/basal radial glia cell division, 122–123
    overview, 112
    prospects for study, 123
    radial glia cell fate
      asymmetric segregation of epithelial substructures, 120–121
      localized determinants, 121
      organelle functions, 121–122
      self-renewal, 112, 114

Branching
  cell behavior control, 89–90
  kidney, 87–88
  lung, 86–87
  mammary gland, 88–89
  outgrowth as basic process reiteration, 90
  overview, 82
  techniques for study, 90–91
  tracheal system of Drosophila, 83–84
  ureteric bud outgrowth and branching regulation
    cell-level branching, 495–496
    glial-derived neurotrophic factor signaling, 494
    receptor tyrosine kinase signaling, 494–495
  vasculature, 84–86

Breast cancer
  ephrin signaling, 146
  epithelial-mesenchymal transition, 131
  Brat1, heart development role, 423–424
  Brn3a
    sensory neuron differentiation role, 254
  Brown adipose tissue. See Adipogenesis

C

Cadherins. See also Cell adhesion
  cell migration regulation, 141–142
  differential adhesion, 139
  N-cadherin in mesenchymal condensation, 348
  paraxial protocadherin, 140
  restricted expression in development, 141
  tumor cell dissemination and epithelial-mesenchymal transition, 145–146
  Calcitonin-like receptor (CLR), 325
  Cancer stem cell (CSC), epithelial-mesenchymal transition, 132
  Cancer. See specific cancers; Tumorigenesis
  Cap mesenchyme. See Kidney
  Cardiac organogenesis. See Heart

Cholecystokinin (CCK), acinar cell regulation in pancreas, 461
  ChIP.
  Cholesr, primitive streak expression, 192
  Cdx42
    apical and basolateral membrane generation, 100–101
    cell polarity regulation, 98
  Cdx6, kidney development, 500
  Cd32
    blastocyst formation, 4
    blastocyst lineage specification, 170–172, 174–175
    gastrointestinal system development, 477–479
  C/EBP, adipogenesis regulation, 302
  C/EBPalpha, hematopoietic stem cell lineage choice role, 216
  Cell adhesion
    differential adhesion
      cell segregation role, 139–140
      cortical tension, 140–142
      ephrin signaling, 143–144
      overview, 138–139
      restricted cadherin expression, 141
      fibroblast growth factor signaling, 67
      integrin activation at somite borders, 144
      migration regulation by cadherins, 141–142
    tumor regulation
      cadherin control of tumor cell dissemination and
        epithelial-mesenchymal transition, 145–146
      ephrin signaling
        breast cancer, 146
        colorectal cancer boundary formation, 146
        prostate cancer, 147
        overview, 144–145
    Cell cortex tension. See Cortical tension
    Cell migration
      cadherin regulation, 141–142
      ephrin signaling, 144
      fibroblast growth factor signaling, 67
    Cell polarity
      apical and basolateral membrane generation, 98–101
      cochlea development and planar cell polarity, 412–413
      epithelial cell
        link between polarity complexes and adhesion complexes in polarity
          establishment, 98
        polarity complexes, 97–98
        tight junctions, 96
        epithelial morphogenesis
          maintenance of architecture during cell division, 102–103
          polarity rearrangements, 103–105
          prospects for study, 105–106
          tissue architecture generation, 101–102
          lung branching regulation, 447
      Celsr1, lung development role, 447
      Centrosome, radial glia cell fate role, 122
      Cerebral cortex. See Brain
      ChIP. See Chromatin immunoprecipitation
      Cholecystokinin (CCK), acinar cell regulation in pancreas, 461

This is a free sample of content from Mammalian Development. Click here for more information or to buy the book.

© 2013 by Cold Spring Harbor Laboratory Press
Index

Cranial neural crest cell.

Coup TFII, lymphatic competence and specification regulation, 323

Cortical tension, cell segregation, 140–142

Cornea, development, 388

Conduction system, formation, 428–429

Colorectal cancer (CRC), ephrin signaling in boundary formation, 146
crc.

CRB, cell polarity regulation, 98

ctip2, neuron fate specification in embryo brain, 272–273

ctcf, 19–20, 24–35

csc.

See Colon.

See Collecting duct.

See Cochlea.

Egg cylinder

EGF.

E-cadherin.

See EC.

EBF1, hematopoietic stem cell lineage choice stability role, 214

ear, See Inner ear

Early gastrula organizer (EGO), 194–195

EBFI, hematopoietic stem cell lineage choice stability role, 214

EC. See Endothelial cell

e-cadherin. See Cadherins

ECM. See Extracellular matrix

Ectodysplasin (Eda), tooth development role, 370–371

Eda. See Ectodysplasin

EGC. See Embryonic germ cell

EGE. See Epidermal growth factor

Egg cylinder
cell types and tissues, 186
development overview, 6–8
heterogeneity

epidermal ectoderm
signaling, 186–187, 189
subpopulations, 185–186
visceral endoderm, 185
EGO. See Early gastrula organizer

Egression
definition, 188
endoderm formation, 195

Embryonic germ cell (EGC), generation from primordial germ cells, 233

Embryonic stem cell (ESC)
derivation, 5–6
epiblast stem cell differentiation, 8
pluripotency transcription factors
knockout/overexpression phenotypes, 9
network for sustaining pluripotency, 9–11
somatic cell pluripotency induction, 11–12
primordial germ cell generation, 231–232
propagation and development with 2i or 3i, 8–9

EMT. See Epithelial-mesenchymal transition

Endothelial cell (EC)
lymphatic endothelial cell differentiation and migration, 323–324
vasculogenesis study prospects, 325–326

Eomes
blastocyst lineage specification, 170
heart development role, 420

Ephrin
cancer signaling
breast cancer, 146
colorectal cancer boundary formation, 146
prostate cancer, 147
cell segregation role
overview, 142–143
signaling
differential adhesion, 143–144
cell migration, 144
heart development role, 426
intestinal cell turnover regulation, 484
mesenchymal condensation role in skeletal development, 348
segmental border formation in somitogenesis, 162

EPL. See Epiblast

Epiblast (EPI). See also Blastocyst
lineage specification transcription factors, 168–172
segregation of epiblast and primitive endoderm, 175–176

Epiblast stem cell (EpiSC)
embryonic stem cell differentiation, 8
functional overview, 6–8
human pluripotent stem cells, 12
primordial germ cell generation, 231–232

Epidermal growth factor (EGF), developmental signaling, 58–59

Epidermis
functional anatomy, 278
stem cells
bulge stem cell, 278–281
cancer initiation
basal cell carcinoma, 287–289
squamous cell carcinoma, 289
genomic maintenance, 286–287
interfollicular epidermis, 281
multipotency and plasticity, 281–283
sebaceous gland, 281
therapeutic applications, 290
tissue differentiation control
epidermal stratification, renewal, and differentiation, 283–284
epigenetics, 285–286
hair follicle morphogenesis and cycling, 284–285

© 2013 by Cold Spring Harbor Laboratory Press
Index

Epigenetics. See also X-chromosome inactivation
autosomal imprinted gene characteristics, 18
epidermal tissue differentiation control, 285–286
germline
CTCF-DMD interaction, 24
DNA methyltransferase targeting during oogenesis, 25–26
overview, 24
H19/IGF2, 18
heart
precursor differentiation, 423–424
reprogramming, 431–432
hematopoietic stem cell self-renewal role, 212
neurogenesis onset and progression in embryo brain, 268
noncoding RNAs
imprinted regulation and dosage compensation, 20–21
repressive nuclear compartment formation, 22–23
primordial germ cell reprogramming, 233–235
tissue-specific imprinting, 23–24
transcriptional interference and gene silencing, 21–22
X-chromosome inactivation, 18
EpiSC. See Epiblast stem cell
Epithelial cell polarity. See Cell polarity
Epithelial-mesenchymal transition (EMT)
alternative splice variants, 130
cadherin control, 145–146
cancer role
breast cancer, 131
cancer stem cells, 132
fibrosis and cancer link, 132
immune evasion, 132–133
definition, 188
functions, 128
mammary gland development, 130–131
overview, 128–130
primitive streak, 191–194
prospects for study, 133–134
transcription factors, 129–130
transforming growth factor-β activation, 129
Epithelial morphogenesis. See Cell polarity
Epithelial rests of Malassez (ERM), 369
Epithelial splicing regulatory protein (ESRP), splice variants in epithelial-mesenchymal transition, 130
ERK. See Extracellular signal-regulated kinase
ERM. See Epithelial rests of Malassez
ESC. See Embryonic stem cell
Esrb, pluripotency role, 9–11
Estrogen, adipogenesis regulation, 306
Etv5, kidney development, 495
Evi1, hematopoietic stem cell self-renewal role, 212
Extracellular matrix (ECM), epithelial polarization, 101
Extracellular signal-regulated kinase (ERK)
developmental signaling, 58–60, 68, 70–71
lung branching morphogenesis role, 87
Eye
anatomy, 382
ciliary body development, 389–390
cornea development, 388
eye field
division, 384
transcription factors
Lhx2, 383–385
overview, 382–383
Pax6, 383, 385, 388
Rax, 384
Six3, 384
iris development, 389–390
lens development, 388
optic cup morphogenesis, 386–387
optical vesicle
boundary establishment, 384–385
neural retina, retinal pigment epithelium, and optic stalk formation, 384–385
retinoic acid and invagination, 387–388
signaling networks, 385
prospects for development and regeneration studies, 393–393
retina
Müller glial cell, 391–392
neural retina axes, 388–389
neurogenesis, 390–391
progenitor cells, 393–393
Ezh2, heart development role, 424
F
Fat. See Adipogenesis
FGF. See Fibroblast growth factor
Fibroblast growth factor (FGF)
branching role in tracheal system of Drosophila, 83–84
cell adhesion and migration signaling, 67
cell differentiation signaling, 67–68
cell fate determination, 66–67
cell proliferation regulation, 65–66
cell survival signaling, 67
cranial neural crest cell fate regulation, 248
cross-talk, 70
developmental signaling, 58–60
FGF3 and inner ear development, 406
FGF4
blastocyst formation, 5
embryonic stem cell differentiation induction, 8
segmentation of epiblast and primitive endoderm, 175–176
FGF5 and epiblast stem cell expression, 7
FGF8
inner ear development, 403, 411
primitive streak formation, 194
FGF9 and lung development role, 447–449
FGF10
acinar specification in pancreas, 459
lung branching morphogenesis role, 86
lung development role, 440–441, 443–447, 450
neural progenitor cell self-renewal role, 114
glial switch role in embryo brain, 269–270
growth plate development role, 353–354
kidney development, 494, 496
mesenchymal condensation role in skeletal development, 349–350
neurogenesis onset and progression in embryo brain, 265
optical vesicle signaling, 385–386
osteoblast differentiation regulation, 358
segmentation clock in somitogenesis, 156, 158, 160–162
tooth development role, 359–370, 372
tooth replacement role, 375
Fibrosis
epithelial-mesenchymal transition and cancer link, 132
renal, 503
Flk1, heart development role, 421
FoxA2
gastrointestinal system development, 477

© 2013 by Cold Spring Harbor Laboratory Press
Index

H

H19/IGF2, epigenetic regulation, 18–19, 24
Hair cell. See Inner ear
Hair follicle. See Epidermis

Hand1, heart development role, 429
Hand2, sympathetic neuron differentiation role, 256
HDAC. See Histone deacetylase
Heart
chambers formation, 425–426
segmentation, 426–428
conduction system formation, 428–429
cushion formation, 428
heart field establishment, 429
overview of development, 420
progenitors and early differentiation
allocation of progenitors, 421–422
epigenticity of early differentiation, 423–424
insights, 424–425
overview, 420–421
signaling in progenitor induction, 422
transcription factors in differentiation, 422–423
repair and maintenance
engineering, 431
epigenticity reprogramming, 431–432
stem cells, 429–431
trabeculation, 420
valve formation, 428
Hematopoiesis
adult
cell differentiation hierarchy, 208–210
cell fate control
extrinsic regulation, 215–216
intrinsic regulation, 216–217
lineage choice stability, 213–215
overview, 211
self-renewal versus differentiation, 211–213
embryo, 207–208
microRNA regulation, 39–40
model systems, 206–207
prospects for study, 217
Hematopoietic stem cell (HSC)
differentiation hierarchy, 208–210
fate choice. See Hematopoiesis
fetal versus adult cells, 208
markers, 208–210
overview, 206
Hepatoblast, differentiation, 481
Hepatocyte. See Liver
Hepatocyte growth factor (HGF)
somitogenesis role, 335
tubulogenesis induction, 104–105
Her1/7, segmentation clock in somitogenesis, 158
HERS. See Hertwig’s epithelial root sheath
Hertwig’s epithelial root sheath (HERS), 369
Hes7, segmentation clock in somitogenesis, 158–159
Hey2, inner ear development, 411
HGF. See Hepatocyte growth factor
Hippo, inner cell mass versus trophoderm signaling, 175
His-Purkinje cell, 428–429
Histone deacetylase (HDAC)
HDAC4 and growth plate development, 355
heart development role, 424
HNF-4a, liver development role, 481–482
Hnf1β, pancreas duct cell development, 461–462
Hnf6, pancreas duct cell development, 461
Hox, cranial neural crest cell expression, 245–246
Hoxb genes, lung development role, 438, 444–445
HoxB4, hematopoietic stem cell self-renewal role, 212
Index

Hoxd13, gastrointestinal system development, 478
HSC. See Hematopoietic stem cell

I
IA2, 467
ICM. See Inner cell mass
Id genes, inner ear development, 409
IHH. See Indian hedgehog
IKNM. See Interkinetic nuclear migration
Imprinting. See Epigenetics
Indian hedgehog (IHH)
gastrointestinal system development, 479
growth plate development role, 353
osteoblast differentiation regulation, 356
Ingression, definition, 188
Inner cell mass (ICM). See also Blastocyst
blastocyst formation, 4–5, 168–169, 171t
lineage specification transcription factors, 168–172
trophoectoderm development comparison, 172–175
Inner ear
anterior–posterior axial specification, 402–403
cochlear duct formation
Atoh1 in hair cell formation, 409, 411
extrinsic signals, 408–409
microRNA in development, 411–412
organ of Corti formation, 409–410
planar cell polarity, 412–413
supporting cell development, 411
dorsal–ventral axial specification, 403–405
medial–lateral axial specification, 405–406
neural and sensory fate specification
cell fate specification, 406
extrinsic signals, 406
relationship between neural and sensory domains, 406–407
overview of development, 400–402
prospects for development and therapy studies, 413–414
semicircular canal and cristae formation
extrinsic signals, 407
patterning, 407–408
Insulin, adipogenesis regulation, 307
Integrins. See also Cell adhesion
activation at somite borders, 144
Intercalation, cells, 188, 195
Interkinetic nuclear migration (IKNM), neural progenitor cells, 114
Intermediate progenitor. See Neural progenitor cell
Intestine development
anterior–posterior patterning
regional identity establishment, 477–478
transcription factors
combinations in determining organ domains, 478
modulation by signaling molecules, 478
overview, 482–484
regional specification and morphogenesis, 478–480
Iris, development, 389–390
Isl1, 430
IsO. See Isthmus organizer
Isthmus organizer (IsO), 64

J
Jag1, inner ear development, 409–410
JAK/STAT signaling, glial switch in embryo brain, 269

© 2013 by Cold Spring Harbor Laboratory Press
patterning and morphogenesis, 480–481
transcription factors in hepatic primordium, 480
Lmk, hematopoietic stem cell self-renewal role, 212
Lrig3, inner ear development, 408
LRP5/6, WNT signaling, 59, 61
Lung
branching morphogenesis, 86–87
embryonic origins
overview, 438–440
transcription factors and signaling molecules, 438–442
branching
cell shape and polarity regulation, 447
epithelial cell proliferation regulation, 444–445
morphogen regulation, 445–447
progenitor cell positioning and differentiation, 444
stereotyped branching patterns, 443–444
mesenchymal growth and differentiation regulation
FGF9, 447–448
overview, 447
smooth muscle differentiation, 449
vascular and epithelial development coordination, 449
Wnt signaling, 448–449
miRNAs in development, 449–450
size and shape regulation, 450–451
prospects for development studies, 451
Lymphatic vessel.
See Vasculogenesis

M
Macrophage colony-stimulating factor (M-CSF), hematopoietic stem cell lineage choice role, 215
Mammary gland
branching morphogenesis, 88–89
epithelial-mesenchymal transition in development, 130–131
Mash1
neurogenesis onset and progression in embryo brain, 267
neuron fate specification in embryo brain, 271
sympathetic neuron differentiation role, 256
Mass spectrometry (MS), proteomics, 45–47
Matrix metalloproteinase (MMP)
growth plate development role, 351–352
MMP-3 and mammary gland development, 130–131
Mbd3, pluripotency role, 9, 11
MCPH. See Autosomal recessive primary microencephaly
NCC. See Neural crest cell
Mesp1, heart development role, 421–422
myogenesis regulation, 338
Mesenchymal-to-epithelial transition (MET)
definition, 188
endoderm formation, 195
Mesp1, heart development role, 420, 422, 425
Mesp2, segmentation clock in somitogenesis, 160, 162–164
MET. See Mesenchymal-to-epithelial transition
Mib1, neural progenitor cell self-renewal role, 114
MicroRNA (miRNA)
biogenesis, organization, and target recognition, 34–36
cell differentiation control, 36
epidermal tissue differentiation control, 285–286
gastrulation regulation, 36
hematopoiesis regulation, 39–40
hematopoietic stem cell self-renewal role, 212
history of study, 34
inner ear development, 411–412
lung development, 449–450
muscle development regulation, 37–39, 338
neural development regulation, 36–37
prospects for study, 40
Mid-gastrula organizer (MGO), 194–195
miRNA. See MicroRNA
Mist1, acinar cell regulation in pancreas, 459–460
Mitotic spindle, orientation control in radial glia cell division
cleavage plane fluctuations, 118–119
defects and disease, 119–120
mechanisms, 117–118
MMP. See Matrix metalloproteinase
Morphogenesis. See Blasto; Branching; Cell adhesion; Cell polarity; Egg cylinder; Eye; Heart; Inner ear; Tooth development
MRE. See Myogen regulatory factor
MS. See Mass spectrometry
Mx2, hematopoietic stem cell self-renewal role, 212
Mxx1, cranial neural crest cell fate regulation, 250–251
Mxx2, cranial neural crest cell fate regulation, 250–251
Müller glial cell, 391–392
Muscle. See Myogenesis
c-Myc, hematopoietic stem cell self-renewal role, 212
Myf5
lung size regulation, 450
myogenesis regulation, 335–337, 339–340, 342
somitogenesis role, 334
MyoD
lung size regulation, 450
myogenesis regulation, 335–337, 339, 341
somitogenesis role, 334–335
Myogenesis. See also Somitogenesis
adult myogenesis
extrinsic regulation, 342
overview, 337
satellite cell
abundance in mouse, 340
niche, 338–339
origins, 340
stem cells, 340–342
gene networks
MEF2, 338
myogen regulatory factors, 335–336
Pax, 336
Six1, 337
Six4, 337
microRNA regulation, 37–39
prospects for study, 342
somitogenesis
morphogen gradients, 334–335
overview, 332–334
Myogenin, myogenesis regulation, 339
Myogen regulatory factor (MRF), myogenesis regulation, 335–336, 342

N
Nanog
blasto; formation, 5
pluripotency role, 9–10
primordial germ cell pluripotency, 232
proteomics, 51
segregation of epiblast and primitive endoderm, 176
N-cadherin. See Cadherins
NCC. See Neural crest cell
Index

Nephron. See Kidney

Neural crest cell (NCC)
cranial cells
ectomesenchymal fate regulation
fibroblast growth factors, 248
overview, 246–247
Sonic Hedgehog, 248
transforming growth factor-β, 248
trunk neural crest cell comparison, 251
Hox expression, 245–246
Msx1 in fate determination, 250–251
Msx2 in fate determination, 250–251
skeletal connective tissue fate determination
Runx2, 249–250
Sov9, 249–250
Wnt, 249–250
functional overview, 244–245
migration and differentiation, 244–245
neural tube delamination, 244–245
prospects for study, 257
trunk neural crest cells
functional overview, 251–253
sensory neuron differentiation
dorsal root ganglia sensory neuron types, 251, 253
neurogenin regulation, 253–254
transcription factors, 254
Wnt signaling, 254
sympathetic neuron differentiation
bone morphogenetic protein regulation, 256
environmental cues in sympatho-adrenal progenitor
differentiation, 256–257
gene cascade, 256
overview, 254–256
Neural progenitor cell (NPC)
cerebral cortex development
asymmetric division in model systems, 115–117
classification of cells, 113
interkinetic nuclear migration, 114
intermediate progenitors and neuron development, 114–115
mitotic spindle orientation control in radial glia cell division
cleavage plane fluctuations, 118–119
defects and disease, 119–120
mechanisms, 117–118
outer/basal radial glia cell division, 122–123
overview, 112
prospects for study, 123
radial glia cell fate
asymmetric segregation of epithelial substructures, 120–121
localized determinants, 121
organelle functions, 121–122
self-renewal, 112, 114
retina, 391
Neuregulins
neurogenesis onset and progression in embryo brain, 265
neuron fate specification in embryo brain, 270–271
NeuroD1, pancreas β-cell maturation, 466–467
Neurogenesis. See also Neural crest cell
microRNA regulation, 36–37
neural plate, 264
neuron fate specification in embryo brain
spatial mechanisms, 270–271
temporal mechanisms, 271–273
onset and progression in embryo brain
epigenetics, 268
glial switch, 268–270
signaling, 264–267
transcription factors, 267–268
Neurogenin
neurogenin1 and inner ear development, 406–407
sensory neuron differentiation regulation, 253–254
Ngn3, pancreas β-cell development, 465
Nkx2.1
foregut tube septation, 442–443
lung development role, 438–439
Nkx2-5, heart development role, 422–424, 429
Nkx6, acinar specification in pancreas, 459
Nodal, visceral endoderm translocation, 190
Noggin
branching role
regionalization during outgrowth, 89
tracheal system of Drosophila, 83
chondrocyte differentiation role, 351
developmental signaling, 64–66
dermal stratification, renewal, and differentiation role, 283–284
foregut tube septation, 443
glial switch role in embryo brain, 269
growth plate development role, 354–355
intestinal cell turnover regulation, 484
kidney development, 500
lung development role, 447, 449
Müller glial cells, 392
neural progenitor cell self-renewal role, 114
neurogenesis onset and progression in embryo brain, 264–265
osteoblast differentiation regulation, 357
segmentation clock in somitogenesis, 156–158, 160
somitogenesis role, 335
somitogenesis role, 335
vascular branching role, 85
vasculogenesis role, 325
NPC. See Neural progenitor cell
Nuclear-mitotic apparatus protein (NuMA), mitotic spindle orientation
cell division, 117, 119
NuMA. See Nuclear-mitotic apparatus protein
O
Oct4
blastocyst formation, 4
blastocyst lineage specification, 168–169, 171, 174
epiblast stem cell expression, 7
pluripotency role, 9–11
primordial germ cell pluripotency, 232
proteomics, 51–52
somatic cell pluripotency induction, 11–12
Optical vesicle. See Eye
Organ of Corti. See Inner ear
Osr1, kidney development, 492–493, 496
Osteoblast, differentiation regulation
API, 360
ATF4, 358–359
bone morphogenetic protein, 357–358
fibroblast growth factor, 358
Indian hedgehog, 356
Notch, 357
osterix, 358, 360
Runx2, 358
Wnt, 356–357

© 2013 by Cold Spring Harbor Laboratory Press
Index

Osterix, osteoblast differentiation regulation, 358, 360
Otx1, ciliary body development, 389

P
p53, squamous cell carcinoma loss, 289
p63, tooth development role, 369–370
PAC. See Parachordal chain
Pax4, extraembryonic ectoderm, 187
Pancreas development
endocrine pancreas
α-cell development, 463–465
β-cell development
dense core granule biogenesis, 467–468
markers of maturity, 465–466
maturity, 465
neonatal proliferation, 467
regulation of maturation, 466–487
overview, 462–463
exocrine pancreas
acinar cell
growth, regeneration, and plasticity, 461
maturation and function, 460
acinar specification, 459–460
duct cell
development and biology, 461
regeneration and plasticity, 462
initiation, 458
overview, 458–459
prospects for study, 468
PAPC. See Paraxial protocadherin
PAR3, apical and basolateral membrane generation, 100–101
PAR6, cell polarity regulation, 98
Parachordal chain (PAC), formation, 85
Parathyroid hormone-related peptide (PTHrP), growth plate development role, 353
Paraxial protocadherin (PAPC), 140
Pax
myogenesis regulation, 336, 339–341
Pax2
inner ear development, 405
kidney development, 493
Pax4 and pancreas α-cell development, 464–465
Pax5 and hematopoietic stem cell lineage choice stability, 214
Pax6
eye field transcription factor, 383, 385, 388
iris development, 390
lens development role, 388
neurogenesis onset and progression in embryo brain, 267–268
neuron fate specification in embryo brain, 270
Pax8 and kidney development, 493
Pax9 and tooth development, 372
PCP
pathway, 71
visceral endoderm translocation, 190
PDGE. See Platelet-derived growth factor
Pdk1, pancreas β-cell maturation, 466
PE. See Primitive endoderm
Periocular mesenchyme (POM), 387
Peroxisome proliferator-activated receptor-γ (PPAR-γ), adipogenesis regulation, 303–304
PGC. See Primordial germ cell
Phosphatidylinositol 3-kinase, developmental signaling, 58, 60
Phosphoinositols, apical and basolateral membrane generation, 100
Phospholipase C (PLC), developmental signaling, 58, 60
Pheox2/2b, sympathetic neuron differentiation role, 256
Pitx2, lung development role, 443
PKC. See Protein kinase C
PKD. See Polycystic kidney disease
Planar cell polarity. See Cell polarity
Platelet-derived growth factor (PDGF)
developmental signaling, 58–59
PdgdB in kidney development, 501
PLC. See Phospholipase C
Pluripotency. See also Embryonic stem cell; Primordial germ cell; Stem cell
epidermal stem cells, 281–283
human pluripotent stem cells, 12
transcription factors
knockout/overexpression phenotypes, 9
network for sustaining pluripotency, 9–11
somatic cell pluripotency induction, 11–12
Polarity. See Cell polarity
Polycystic kidney disease (PKD), 502
POM. See Periocular mesenchyme
Pou3f3 (Brn1), kidney development, 500
Pou3f4, inner ear development, 409
PPAR-γ. See Peroxisome proliferator-activated receptor-γ
Pref-1, adipogenesis regulation, 305
Presomitic mesoderm. See Somitogenesis
Prlc2, inner ear development, 412
Primitive endoderm (PE). See also Blastocyst
lineage specification transcription factors, 168–172
segregation of epiblast and primitive endoderm, 175–176
Primitive streak
cell behavior during formation, 193–194
epithelial-mesenchymal transition, 191–194
germ layer formation, 192–193
markers, 192
spatiotemporal regionalization, 194–195
Primordial germ cell (PGC)
epigenetic reprogramming, 233–235
generation from pluripotent stem cells, 231–232
germ cell development overview in mice, 224–225
pluripotency
embryonic germ cell differentiation, 233
genes, 232–233
prospects for study, 235–236
specification
functions of genes and proteins
BLIMP1, 226–227, 230
PRDM14, 230
table of genes, 228–229
TCFAP2C, 230
gene expression dynamics, 225–227
preformation versus epigenesis, 225
signaling, 230
Prostate cancer, ephrin signaling, 147
Protein kinase C (PKC)
apical and basolateral membrane generation, 100–101
inner cell mass versus trophoderm development, 173, 175
Proteomics
challenges, 46–47
mass spectrometry, 45–47
posttranslational modifications, 47–48
quantitative proteomics, 48–49
stem cells
membrane proteomics, 50
phosphoprotein dynamics, 51–53
prospects for study, 54
Index

Proteomics (Continued)
protein dynamics, 50–51
protein—protein interactions, 51
rationale for study, 44, 49–50
Proxl, lymphatic competence and specification regulation, 323
Ptbp1, 467
Pten, hematopoietic stem cell self-renewal role, 212
PTF1, acinar cell regulation in pancreas, 459–460
PTHrP. See Parathyroid hormone-related peptide
Pu.1, hematopoietic stem cell lineage choice and stability role, 214, 216–217

R
RA. See Retinoic acid
Rac1
cell polarity regulation, 98
visceral endoderm translocation, 190
Radial glia. See Neural progenitor cell
Ras
developmental signaling, 58–60, 65–66
epidermal stratification, renewal, and differentiation role, 283
K-Ras, squamous cell carcinoma role, 289
Rax, eye field transcription factor, 384
Receptor tyrosine kinase (RTK)
developmental signaling, 58, 60, 66
feedback regulation
negative feedback, 68–69
positive feedback, 68
kidney development, 494–495
Renal vesicle. See Kidney
Ret, kidney development, 494–496
Retina. See Eye
Retinoic acid (RA)
gastrointestinal system development, 478
inner ear development, 402–403
lung development role, 442, 444
optical vesicle invagination, 387–388
Rho
cell polarity regulation, 98
lung size regulation, 450
RNA-induced silencing complex (RISC), 34–35
RNA polymerase II
microRNA biogenesis, 34
transcriptional interference and gene silencing, 21–22
ROCK
basement membrane remodeling role, 102
lung size regulation, 450
Ror2, inner ear development, 413
RTK. See Receptor tyrosine kinase
Runx2
cranial neural crest cell fate regulation, 249–250
growth plate development role, 355
osteoblast differentiation regulation, 358

S
Satellite cell
abundance in mouse, 340
niche, 338–339
origins, 340
stem cells, 340–342
SCC. See Squamous cell carcinoma
Sdf1, 141
Segmentation clock, somitogenesis
classical model, 156
clock genes, 156–157
mouse, 158–160
synchronized oscillation, 160
translation into spatial information
oscillation translation to segments in wavefront, 160–162
rostrocaudal polarity, 162
segmental border formation, 162
zebrafish, 157–158
Semicircular canal. See Inner ear
Septation
foregut tube, 442–443
heart chambers, 426–428
SHH. See Sonic Hedgehog
Six1, myogenesis regulation, 337
Six2, kidney development, 496–498
Six3, eye field transcription factor, 384
Six4, myogenesis regulation, 337
Skeletal
chondrocyte differentiation signaling, 350–351
SOX proteins, 350
cranial neural crest cell and connective tissue fate determination
Runx2, 249–250
Sos9, 249–250
Wnt, 249–250
growth plate development overview, 351–353
regulation
bone morphogenetic protein, 354
fibroblast growth factor, 353–354
HDAC4, 355
Indian hedgehog, 353
Notch, 354–355
parathyroid hormone-related peptide, 353
Runx2, 355
Wnt, 354
mesenchymal condensation, 348–350
osteoblast differentiation regulation
API1, 360
ATF4, 358–359
bone morphogenetic protein, 357–358
fibroblast growth factor, 358
Indian hedgehog, 356
Notch, 357
osterix, 358, 360
Runx2, 358
Wnt, 356–357
prospects for study, 360
Skin. See Epidermis
SMADs
mesenchymal condensation role in skeletal development, 348
SMAD1, integration of signaling pathways, 70
sympathetic neuron differentiation role, 256
Small intestine. See Intestine development
SmoM2, basal cell carcinoma role, 287–289
SNS. See Sympathetic nervous system
Somaticogenesis. See also Myogenesis
dorsoventral patterning, 154–155
integrin activation at somite borders, 144
overview, 152–153
paraxial mesoderm derivation, 152
presomitic mesoderm derivation, 152, 154

© 2013 by Cold Spring Harbor Laboratory Press
regionalization along anteroposterior axis, 155–156
segmentation clock
classical model, 156
clock genes, 156–157
mouse, 158–160
synchronized oscillation, 160
translation into spatial information
oscillation translation to segments in wavefront, 160–162
rostrocaudal polarity, 162
segmental border formation, 162
zebrafish, 157–158
somite number determination, 162, 164

Sonic Hedgehog (SHH)
cranial neural crest cell fate regulation, 248–249
developmental signaling, 62–63, 66
foregut tube septation, 443
gastrointestinal system development, 479
hair follicle morphogenesis and cycling role, 285
inner ear development, 403–405, 407
kidney development, 501
lung branching morphogenesis role, 87
lung development role, 442–443, 446–447
optical vesicle signaling, 386
regulation of signaling, 69
somitogenesis role, 334
tooth development role, 372
tooth replacement role, 375

SOX
chondrocyte differentiation role, 350
lymphatic competence and specification regulation, 322–323
primordial germ cell pluripotency, 232
SOX2
blastocyst formation, 4
inner ear development, 409–410
iris development, 390
lens development role, 388
paraxial mesoderm derivation, 152
pluripotency role, 9–11
proteomics, 51–53
Sox6, neuron fate specification in embryo brain, 271
SOX9
cranial neural crest cell fate regulation, 249–250
mesenchymal condensation role in skeletal development, 349
Sox17 and blastocyst lineage specification, 5, 171
Spc proteases, extraembryonic ectoderm, 187
Sprouty (Spry)
lung development role, 445–446
Sprouty1 in kidney development, 494–495
Sprouty2, lung branching morphogenesis role, 86–87
Spry. See Sprouty
Squamous cell carcinoma (SCC), epidermal stem cells in initiation, 289
SREBP-1. See Sterol response element-binding protein-1

T
TAF. See Tumor-associated fibroblast
Tbx1
heart development role, 428
inner ear development, 409
lung development role, 441
Tbx2, heart development role, 422, 428–429
Tbx3
heart development role, 429, 431
pluripotency role, 9–11
Tbx4, lung development role, 441
Tbx5, heart development role, 422–423, 426–429
Tbx18, heart development role, 421
Tbx20, heart development role, 424
Tcf, kidney development role, 498
Tcf3, pluripotency role, 9, 11
TE. See Trophoectoderm
Tead4
blastocyst formation, 4
blastocyst lineage specification, 170

Teeth. See Tooth development
TET proteins, primordial germ cells, 234–235
TGF-β. See Transforming growth factor-β
Thyroid hormone, adipogenesis regulation, 305–306
Tip, regionalization of branches during outgrowth, 89
TLX, 36–37

Tooth development
cell lineage identification and differentiation, 371–373
human versus mouse, 368
morphogenesis and cell differentiation, 369
prospects for study, 376–377
replacement regulation, 373–375
signaling, 369–371
stem cell-based engineering, 375–376
Trabeculation, heart, 426
Trachea, formation, 442–443
Transforming growth factor-β (TGF-β)
cranial neural crest cell fate regulation, 248
epithelial-mesenchymal transition activation, 129
lung development role, 443
mammary gland branching morphogenesis role, 88
tooth development role, 373–374
TRIM32, neurogenesis onset and progression in embryo brain, 268
Trophoectoderm (TE). See also Blastocyst
anatomy, 184
inner cell mass development comparison, 172–175
lineage specification transcription factors, 168–172
Index

Trunk neural crest cell. See Neural crest cell
Tsix, 26–27
Tubulogenesis, hepatocyte growth factor induction, 104–105
Tumor-associated fibroblast (TAF), 147
Tumorigenesis
cell adhesion regulation
cadherin control of tumor cell dissemination and epithelial-mesenchymal transition, 145–146
ephrin signaling
breast cancer, 146
colorectal cancer boundary formation, 146
prostate cancer, 147
overview, 144–145
epithelial-mesenchymal transition role
breast cancer, 131
cancer stem cells, 132
fibrosis and cancer link, 132
immune evasion, 132–133

U
UCP-1. See Uncoupling protein-1
Uncoupling protein-1 (UCP-1), 298, 300
Ureter. See Kidney

V
Valves, formation in heart, 428
Vascular endothelial growth factor (VEGF)
developmental signaling, 58–59
isoforms in vasculogenesis, 324–325
sprouting angiogenesis and blood vessel network formation, 320–321
vascular branching role, 85
Vasculogenesis
blood vessels
angioblast specification and migration, 318–320
artery–vein differentiation, 321
lumen formation, 321
sprouting angiogenesis and blood vessel network formation, 320–321
branching control, 84–86
genetic networks, 324–325
kidney, 497
lung development role, 449
lung vascular and epithelial development coordination, 449
lymphatic vessels
diastolic cell differentiation and migration, 323–324
overview, 321–322
transcriptional regulation, 322–323
prospects for study, 325–326
\( \text{VAX} \), retinogenesis, 388–389

W
VEGF. See Vascular endothelial growth factor
Vein. See Vasculogenesis
Vessel. See Vasculogenesis
Visceral endoderm. See Anterior visceral endoderm; Distal visceral endoderm

W
W/W complex, visceral endoderm translocation, 190
White adipose tissue. See Adipogenesis
Wnt
adipogenesis regulation, 304–305
anterior visceral endoderm antagonism, 191
canonical signaling, 59–60
chondrocyte differentiation role, 351
cranial neural crest cell fate regulation, 249–250
cross-talk, 70
developmental signaling, 59–62, 66
gastrointestinal system development, 477, 480
growth plate development role, 354
hair follicle morphogenesis and cycling role, 284
heart development role, 422
inner ear development, 404, 407, 413
intestinal cell turnover regulation, 482
kidney development, 498, 501
lung development role, 439–440, 443, 445, 447–449
noncanonical signaling, 60–62
osteoblast differentiation regulation, 356–357
paraxial mesoderm derivation, 152
primordial germ cell specification signaling, 230–231
regulation of signaling, 69
segmentation clock in somitogenesis, 156, 160
sensory neuron differentiation signaling, 254
somitogenesis role, 334
tooth development role, 369, 372–373
tooth replacement role, 374–375
vasculogenesis role, 324–325
Wnt3 and primitive streak expression, 192
Wt1, kidney development, 500–501

X
X-chromosome inactivation (XCI)
noncoding RNAs, 20–23, 26–27
overview, 18
random X-chromosome inactivation, 26–28
XCI. See X-chromosome inactivation
Xi, 22–23
Xist, 20–23, 26–27
Yap1, blastocyst lineage specification, 170, 174