

Index

a

- acellular grafts 473–474
- acoustofluidic perfusion bioreactor 185
- acquired laryngotracheal stenosis 367
- actin filaments 472
- active silicon nanotube transistors (ANTTs) 686
- adenoid cystic carcinomas (ACC) 368
- adenosine triphosphate (ATP) 64
- adenoviruses 89
- adipose-derived stem cells (ADSCs) 190, 225, 250, 485
- adipose tissue-derived stromal cells 224
- adult stem cells 659
 - hematopoietic stem cells 91
 - mesenchymal stem cells 91
 - Wharton's jelly stem cell 92
- agarose 257
- alginate 256, 452
- alginate-AuNW nanocomposites 684
- alginic acid 50, 148
- aliphatic polyesters 450
- alkaline and acid treatments 607
- allograft osteochondral transplantation 247
- allografts 370, 475
- α -hydroxyl esters 538
- amine precursor uptake and decarboxylation system (APUD) 366
- amnion derived mesenchymal cells (AMSCs) 660
- amniotic fluid stem cells (AFSCs) 251
- angioblasts 329
- angiogenesis 329
- angiogenic growth factors (GFs) 333
- anisotropic scaffolds 621
- anterior cruciate ligament (ACL) 470, 474
- antifouling coatings 156
- anti-vimentin antibodies 414
- aortic endothelial cell (AEC) 115
- Apligraf® 47, 222, 228
- arginine-glycine-aspartic acid (RGD) 57
- articular cartilage 125
- adulthood 243
- bone marrow simulation-based techniques 246
- cell-based regenerative technique 247
- composition and structure 243, 244
- embryonic development 243
- function 244
- lesions 245, 246
- osteochondral transplantation techniques 246
- tissue engineering 247, (*see also* articular cartilage tissue engineering)
- articular cartilage tissue engineering
- adipose-derived stem cells 250
- agarose 257
- alginate 256
- amniotic fluid stem cells 251
- biomimetic hierarchical 268
- bone marrow-derived stem cells 249

- articular cartilage tissue engineering
(*contd.*)
- cartilage ECM-derived scaffolds 269
cartilage regeneration 271, 273
chitosan 257
chondrocytes 249
collagen 254
controlled delivery of biochemical factors 265
embryonic stem cells 251
FGF-2 263
fibrin 255
gelatin 255
gene therapy 267
hyaluronic acid 257
IGF-1 263
induced pluripotent stem cells 252
kartogenin 264
mechanical stimuli 264
muscle-derived stem cells 251
parathyroid hormone-related protein 263
poly (ethylene glycol) 259
poly (N-isopropylacrylamide) 259
polyester 258
polyurethane 259
properties for scaffolds 253
PRP 264
scaffold-free cartilage tissue engineering 270, 272
synovium-derived stem cells 250
transforming growth factor-beta 262
arytenoid cartilages 364
asialoglycoprotein receptors 50
asthma 391
autografts 217, 371, 474
autologous adipose-derived stem cells (ADSCs) 53
autologous chondrocyte implantation (ACI) 247
autologous chondrocyte transplantation (ACT) 15
autologous endothelial progenitor cells (EPCs) 273
autologous iPSC-derived endothelial cells (iECs) 115
autologous osteochondral transplantation 247
autologous tissues 374
- b**
- basal cells 365
benign tumors 367
of larynx 368
 β -mercaptopropanoic acid (BMP) 99
biaxial aligned nanofibers 117
bilayered models 221
bilayered TES 220
bioactive material-based techniques 338, 339
bioartificial pancreas
alginate 559
biocompatibility 558
bioengineering approach 556
biology of pancreas and islets 554
cell surface coating 562
clinical studies 565
diabetes mellitus 553
direct reprogramming 558
exogenous insulin treatment 554
fibrosis 562
human islets 557
human pluripotent stem cells 557
hydrogels 559
islet isolation 557
islets of Langerhans 553
macrocapsules 559
macroencapsulation 560
medical device 555
microencapsulation 561
pancreatic islet transplantation 555
pig islets 556, 557
protection from immune attack 563
transplantation site 563, 564
in vivo gene therapy 555
whole organ pancreas transplantation 554
bioceramics 122
biocompatibility 39
biocompatible polyethersulfone (PES)
hollow fiber 178
biodegradable 3D scaffold 478
biodegradation of scaffold 627

- bio-electrospinning 483
 biofabrication 63
 biologics and drug-based treatment 667
 biomaterials 371
 biomaterial-tissue interactions 37–39
 biomimetic scaffolds 69
 cell-biomaterial interactions 37, 67
 cell-specific binding sites 37
 challenges 65
 controllable degradation 35
 conventional fabrication methods 61–63
 ECM 35
 high-throughput microarray technique 69
 mechanical properties 35
 natural, (*see* natural biomaterials)
 properties 40–43
 rapid prototyping 64
 scaffold requirements for specific tissues 44
 scaffolds 35
 synthetic, (*see* synthetic biomaterials)
 testing 64, 66
 biomaterials and scaffold production 10
 biomimetic artificial larynx 382
 biomimetic hierarchical cartilage tissue engineering 268
 biomimetic scaffolds 69
 biomimicry 535
 bionic systems
 cellular alignment 677
 cochlear implants 678
 degradable batteries 689
 flexible solid-state microelectronics 687
 high-resolution device arrays 678
 inductively coupled systems 689
 integrated biocompatible systems 678
 neuromuscular-electrode interface 679
 organic electronics 681
 piezoelectrics 691
 polymer tissue scaffolds 677
 retinal implants 679
 solid-state nanomaterials 683
 3D printing 693
 bioreactors 424, 427, 491
 advantages and disadvantages 171
 bladder, uterine, and cornea tissue engineering 189
 cardiovascular tissue engineering 187–189
 liver tissue engineering 176
 and mechano-chemical stimulators 532, 534, 535
 microfluidic 174, 175
 musculoskeletal tissue engineering 179
 neural tissue engineering 185
 organ-on-a-chip devices 170
 perfusion, (*see* perfusion bioreactors)
 rotating wall vessels 172
 spinner flasks 171, 172
 three dimensional (3D) scaffolds 169
 uniform cell distributions 169
 wave bioreactors 172, 173
 bio-scaffold based technologies
 decellularization 588, 590
 implantation and vascularization of kidney scaffolds 593
 organ printing 594
 recellularization of acellular renal sections 592
 recellularization of whole kidney scaffolds 591
 biosensors
 antifouling coatings 156
 cell adhesion 150
 colorimetry using gold nanoparticles 145
 electrochemical methods 146
 fundamentals 143
 integrated tissue scaffold 155
 metabolites 147
 microfluidic chips 154
 nanowire field-effect transistors 150
 nitric oxide 157
 oxygen monitoring 148

- biosensors (*contd.*)
 - reactive oxygen species 149
 - templated porous scaffolds 157
- bladder, uterine, and cornea tissue engineering 189
- blood vessel formation 144
- BMP2 gene-modified iPSC-MSCs 125
- bone marrow-derived adult stem cells 659
- bone marrow-derived stem cells (BMSCs) 225, 249
- bone marrow mesenchymal stem cells (BM-MSC) 224, 381
- bone marrow mononuclear cells (BMMNCs) 497
- bone marrow simulation-based techniques 246
- bone marrow stromal cells (BMSCs) 18
- bone morphogenetic protein (BMP) 13, 17, 262, 334
- bone morphogenetic protein 7 (BMP7) 583
- bone morphogenic protein 2 (BMP2) 125
- bone tissue engineering 17, 92, 93, 96, 121
 - behavior of cells 530
 - bioreactors and mechano-chemical stimulators 532, 534, 535
 - bone cells 525
 - cell-biomaterial interface 529
 - cellular growth 530
 - epigenetic machinery 526, 527
 - flap pre-fabrication approach 542
 - functions of bone tissue 525
 - growth hormones 531
 - low-density lipoprotein receptor-related protein 5, 545
 - mechanics and bone cell activities 539
 - mechano-sensors 541
 - mesenchymal stem cells 530
 - microarrays of peptides 531
 - nanoparticle delivery systems 539
 - nanostructured scaffolds 538
- osteocyte-osteoblast communication 541
- osteogenesis 525
- osteogenic progenitors 543
- pre-existence of vascular networks 543
- protein kinase signaling 545
- scaffolds and biomaterials 526
- sourcing 528
- 3D bio-printing 534
- vasculogenic progenitors 543
- Bowman's space 577
- branched-nanotube intracellular field effect transistors (BIT-FETs) 686
- brush cells 366
- C**
- Ca²⁺ cycling 130
- cadaveric allografts 217
- calcium-deficient nanohydroxyapatite (d-HAp) 122
- calcium phosphates (CaP) 122
- Canals of Hering (CoH) 302
- cancer biomarker CA-125 147
- cancer of larynx/hypopharynx 368
- CaP cement (CPC) scaffolds 122
- capsular ligaments 470
- carbon nanotubes (CNTs) 667, 683
- cardiac biowire bioreactor 188
- cardiac progenitor cells (CPC) 422
- cardiac tissue architecture 414, 415
- cardiac tissue engineering 19, 97, 127
 - benefits and limitations of available cell sources 417
 - bioreactors 424, 427
 - cardiac progenitor cells 422
 - cardiac tissue architecture 414, 415
 - cell sheets 424, 427
 - decellularized scaffolds 424, 426
 - embryonic stem cells 418
 - engineered cardiac tissues 428, 429
 - hydrogels 423, 424
 - induced pluripotent stem cells 420, 421
 - mesenchymal stem cells 416
 - prefabricated scaffolds 423, 424

- resident cardiac stem cells 422
 cardiac tissue scaffolds 684
 cardiomyocytes (CMs) 97, 127, 416
 cardiovascular tissue engineering 187, 189
 cartilage ECM-derived scaffolds 269
 cartilage regeneration 271, 273
 cartilage-specific ECM 54
 cartilage-stimulating chondrogenesis 51
 cartilage tissue engineering 16, 96, 125
 C2C12 myoblasts 182
 CdSe and CdS quantum dots 150
 cell adhesion 150
 cell based and neuroprotection therapeutic strategies 658, 659
 cell-based regenerative technique 247
 cell-biomaterial scaffold interactions 67
 cell co-culture-based techniques 335, 336
 cell-laden hydrogels 117
 cell-laden scaffolds 179
 cell-matrix (scaffold) interaction 118
 cell seeding density 119
 cell sheet engineering 8, 331
 cell sheets 424, 427
 secreted ECM matrix 117
 cell signaling research and bioreactor development 11, 12
 cell sourcing and cell manipulation 10
 cell surface coating 562
 cellular and drug delivery 407
 ceramic β -TCP scaffold 544
 chemical decellularization
 alkaline and acid treatments 607
 hypotonic and hypertonic treatment 611
 non-ionic detergent treatment 608
 tri(n-butyl)phosphate treatment 611
 zwitterionic detergent treatment 610
 chitosan 51, 257
 chondrocyte dedifferentiation 16
 chondrocytes 96, 249
 chondroid hamartomas 367
 chondroitin sulfate (CS) 243
 chorioallantoic membrane (CAM) test 65
 chronic kidney disease (CKD) 575
 chronic obstructive pulmonary disease (COPD) 391, 392
 ciliated columnar cells 365
 CNT-reinforced composites 539
 cochlear implants 678
 collagen 46, 48, 254, 604
 collagen-based biomaterials 614
 collagen-based hydrogels 488
 collagen-based synthetic bioscaffolds 477
 collagen microsponges 47
 collagenous bioscaffolds 478
 collagenous synthetic analogs (CSA) 477
 collagen-poloxamine hybrid biomaterials 46
 collagen-polyethylene glycol
 fibrin-based bilayer hydrogels 228
 collagen-rich ECM bioscaffolds 473
 collagen type I protein 467
 colorimetry using gold nanoparticles 145
 corniculate and cuneiform cartilage 364
 cricoid cartilage 364
 C-shape cartilage-rings 365
 cultured epithelial autografts (CEA) 226
 cytochrome P450 (CYP) 20
 CytodexTM type 3 microcarriers 183
 cytoskeleton 119
- d**
- danger-associated molecular pattern molecules (DAMPs) 454
 debrided adipose stem cells (dsASCs) 229
 decellularized ECM-derived scaffold matrices 117
 decellularized mouse heart scaffolds 129
 decellularized renal scaffolds 576
 decellularized scaffolds 128, 424, 426

- decellularized tissue approach 400, 402
 decellularized tissue-engineered heart valves (dTEHVs) 454
 decellularized tissues 453
 deglutition process 365
 degradable batteries 689
 demineralized bone matrix (DBM) 16
 dense core granule cells 366
 dentin matrix protein 1 (DMP1) 541
Dermagraft® 227
 dermal models 221
 dermal substitutes 227
 dermo-epidermal skin substitutes 228
 devitalization process 269
 diabetic skin-humanized mouse model 231
 diffuse papillomatosis 367
 Discoidin Domain Receptor 2 (DDR2) 414
 DKK-1 542
 donor neural cells 659
 dynamically perfused chip-based bioreactor 223
 dynamic optical projection stereolithography (DOPSL) 618
- e**
 ECM proteins 120, 665
 ELAC bioscaffolds 477
 elastin 55, 56, 327
 elastin-based biomaterials 55
 elastin-like polypeptides 55
 electrochemical blocking assays 147
 electrochemically aligned collagens (ELAC) 477
 electrochemical methods 146
 electrospinning technique 337
 electrospun collagen nanofibers 614
 electrospun fibers 51
 electrospun galactosylated chitosan nanofibers 51
 electrospun PLLA/d-HAp nanocomposite 122
 electrospun polymer matrices 120
 electrospun poly(ϵ -caprolactone) (PCL) scaffolds 185
 embryonic bodies 668
 embryonic kidney cells 582, 585
 embryonic lung progenitors 399
 embryonic stem cells (ESC) 88, 251, 418, 456, 659
 endothelialized reconstructed skin (ERS) model 228
 endothelial progenitor cells (EPCs) 329, 455, 660
 end-stage renal disease (ESRD) 575
 engineered cardiac tissues (ECT) 428, 429
 engineered corporal tissue 18
 engineered neural tissue (EngNT) 615
ENTegral™ 372
 enzymatic decellularization 612
Epicel® 15, 220, 226
 epidermal melanocytes 131
 epidermal models 220
 epidermal skin regeneration 226
 epidermal TESs 220
 epidermis-derived keratinocytes 226
 epiglottis 364
 episomal plasmids 89
 epithelial tumors 367
 exocrine pancreatic insufficiency (EPI) 553
 exogenous enzymes 257
 exogenous insulin treatment 554
 exogenous stem cell therapy 406
 extracellular matrix (ECM) 8, 97
 extracellular signal-regulated kinase (ERK) 546
 extracorporeal bioartificial liver (BAL) devices 297
 extracorporeal membrane oxygenation (ECMO) 405
 extracorporeal shockwave treatment (ESWT) 497
 extravascular macrocapsule devices 560
ex vivo tissue engineering 375
- f**
 fate-restricted multipotent adult stem cells 111
 FGF-2 263

- fiber sacrificing method 337
 fibrin 53, 255
 fibrin-based biomaterials 619
 fibrin/HA composite hydrogel 377
 fibroblast-containing scaffolds 231
 fibroblast growth factor 2 (FGF2) 13,
 583
 fibrocartilage 245
 fibronectin (Fn) 122, 467, 667
 coating 120
 fibronectin-like engineered protein
 polymer (FEPP) 123
 fibrosis 562
 field-effect transistors (FETs) 150
 fixed/packed-bed bioreactors (PBR)
 172, 174
 flap pre-fabrication approach 542
 flat plate bioreactors 176
 flexible collagen-I coated
 polyacrylamide gel substrates
 128
 flexible solid-state microelectronics
 687
 flexor digitorium profundus (FDP)
 474
 flexor digitorium superficialis (FDS)
 474
 fluidized-bed bioreactor systems 177
 fluorescence-based oxygen sensors
 149
 fluorescence spectroscopy 146
 force and pressure decellularization
 612
 foreign body response (FBR) 37, 38
- g**
- galactosylated alginate microcapsules
 50
 galactosylated silk fibroin 54
 gelatin 52, 255
 Geltrex 123
 genetically-engineered proteins 122
 glial cell-derived neurotrophic factor
 (GDNF) 581
 Glisson's capsule 299
 glomerular filtration barrier 579, 580
 glucose oxidase (GOx) 143
- glucose sensing 146
 glutaraldehyde (GA) 474
 glycosaminoglycans (GAGs) 47, 452,
 604
 goblet cells 365
 GraftJacket™ 473
 grafts
 allografts 370
 autografts 371
 implantation of non viable tissues
 369
 tracheal transplantation and
 autografts 370
 green fluorescent protein (GFP) 127
 growth-associated protein 43 (GAP-43)
 660
 growth factor-based techniques 333
- h**
- hamartomas 367
 Hayff-11 49
 heart valve biology 445
 heart valve tissue engineering (HVT)
 aliphatic polyesters 450
 cells derived from vasculature 455
 challenges and limitations 456
 decellularized tissues 453
 disease and valve replacement 447
 heart valve biology 445
 pluripotent and induced pluripotent
 stem cells 456
 polysaccharide-based scaffolds 452
 protein-based scaffolds 453
 umbilical cord-derived cells 455
 valvular construct 448
 hematopoietic stem cells 91
 hemodynamics 307
 heparin 52
 heparinized PCL-PHB
 (poly(β -hydroxybutyrate)
 scaffolds 134
 hepatic progenitor cells (HPCs) 302
 hepatic stem cells (HSCs) 302
 histone lysine methyltransferase MII2
 116
 hollow-fiber bioreactors (HFB) 172,
 173, 184

- human adipose tissue derived MSCs (hAT-MSCs) 401
- human bone-marrow derived mesenchymal stem cells (hBM-MSCs) 401
- human-derived ES cells (hESCs) 127
- human-derived iPSCs (hiPSCs) 127
- human dermal fibroblasts (HDFs) 333
- human ESC-derived cardiomyocytes 420
- human feeder cells (HFC) 115
- human hepatocellular carcinoma-derived FLC-4 cells 54
- human iPSCs-derived mesenchymal stem cells (hiPSC-MSCs) 121
- human islets 557
- human neural precursor cells (hNPCs) 186
- human placental mesenchymal stem cells (hpMSC) 173
- human pluripotent stem cells 557
- human skeletal stem cells (hBMSCs) 544
- human umbilical vein endothelial cells (HUVEC) 187, 591, 693
- hyaluronan (HA) 118
- hyaluronan-based biomaterials 616
- hyaluronic acid 47, 257
- hybrid artificial liver bioreactor 178
- hydrocyanines 150
- hydrogels 8, 423, 424
- hydroxyapatite (HAP) 122, 544
- hypotonic and hypertonic treatment 611
- hypoxia-inducible factor 1 (HIF-1) 334
- i*
- idiopathic pulmonary fibrosis 394
- IGF-1 263
- immortalized porcine brain microvascular endothelial cells (PBMEC/C1–2) 186
- immunosuppressant drugs 363
- implantable glucose sensor 157
- implantable laryngeal prosthesis 371
- implantable organs 15
- implantation and vascularization of kidney scaffolds 593
- implantation of non viable tissues 369
- induced pluripotent stem cells (iPSCs) 10, 89, 252, 378, 420, 421, 660
- advanced cell technology 115
- advantages 111
- aortic endothelial cell 115
- bi-cistronic lentiviral vectors 114
- bioactive proteins 114
- bone tissue engineering 121
- cardiac tissue engineering 127
- cartilage tissue engineering 125
- cell-matrix (scaffold) interaction 118
- cell sources 117
- culture conditions 114
- drug discovery and development 113
- epigenetic changes 116
- extracellular matrix 111
- FDA-approved clinical trials 115
- feeder-dependent protocol 114
- feeder-free protocol 114
- genetically reprogrammed adult cells 113
- histone lysine methyltransferase MII2 116
- hyaluronan 118
- immune response 115
- integration-free reprogramming approach 116
- knockout-serum replacement 115
- lentiviral expression system 113
- limitations 116
- murine fibroblasts 113
- nanofibrous scaffolds 112
- neural disorders 116
- neural tissue engineering 132
- non-viral reprogramming methods 114
- patient-specific 112
- PiggyBac vector 114
- pluripotent-specific transcription factors 113
- progenies 112

- scaffold-based tissue engineering 116
sendai-based reprogramming vectors 114
single cassette reprogramming vector 114
skin tissue engineering 131
StemFit 115
3D PCL/gelatin scaffolds 118
transforming growth factor β 3 118
xeno-free culture conditions 115
inductively coupled systems 689
inflammatory rheumatoid arthritis (RA) 245
injectable scaffolds 687
inorganic materials 527
Integra 47
Integra[®] Dermal Regeneration Template 221
integrated biocompatible systems 678
integrated tissue scaffold 155
integrin 119
integrin $\alpha 3/\beta 1$ 590
integrin-linked kinase (ILK) 416
interleukin (IL) 225
interleukin-6 (IL-6) production 662
International Association of Laryngectomees 368
interstitial lung disease (ILD) 390
intramembranous and endochondral ossification 525
inverted colloidal crystal (ICC) scaffold 132
in vitro bioreactor systems 448
in vitro models for disease studies 19
in vitro prevascularization 332
in vitro wound healing models 231
in vivo prevascularization 331
in vivo tissue engineering 375
in vivo wound healing applications 230
ionic detergent treatment 608
ion-selective electrode (ISE) technique 148
iPSCs 87
 derived CMs 127
 derived GFP 127
Islets of Langerhans 553
- j**
jellyfish collagen scaffold 46
- k**
kartogenin 264
keratin sulfate (KS) 243
kidney recellularization 592
kidney vascularization 580
knockout-dulbecco's modified eagle's medium (KO-DMEM) 115
- l**
lacuna 244
laminin coated scaffolds 132
large diameter vascular grafts 344
laryngeal tissue engineering 378
laryngeal transplantation 369
laryngotracheal stenosis 366
larynx 364
laser photolithography technique 333
Laserskin[®] 220, 226
Leghorn chicken's flexor digitorium profundus (FDP) tendons 475
lentiviral expression system 113
ligaments 470
1,4-linked 3,6-anhydro- α -L-galactose 256
1,3-linked β -D-galactose 256
liver biology
 cell types 302
 extracellular matrix 303
 histological structure 300
 organ scale anatomy 299
liver biomechanics
 hemodynamics 307
 properties 304
liver engineered tissues 20
liver mechanobiology
 cellular mechanotransduction 309
 cellular scale mechanical forces 308
 mechanosensitivity 310
liver sinusoidal endothelial cells (LSECs) 302
liver tissue engineering
 perfusion bioreactors 177, 180
 rotating wall vessel bioreactors 176
scaffolds 313

- liver tissue engineering (*contd.*)
 spinner flasks 176
 living tissue engineered bilayered skin
 model 222
Lotus tetragonolobus lectin (LTL) 582
 low-density lipoprotein receptor-related
 protein 5, 545
 low-intensity pulsed ultrasound (LIPUS)
 497
 lung parenchyma engineering 399
 lung tissue engineering
 decellularized tissue approach 400,
 402
 dimensional printing 403
 lung parenchyma engineering 399
 tissue engineered trachea 397, 398
 vascularization 400
 lung volume reduction (LVR) 393
- m**
- macroencapsulation 560
Matricel® 473
 matrix metalloproteinase (MMP)-13
 250
 mechano-sensors 541
 mechanotransduction 416
 medial collateral ligament (MCL) 470
 mesenchymal progenitor cells (MPCs)
 124
 mesenchymal stem cells (MSCs) 91,
 416, 485
 adipose-derived stem cells 250
 amniotic fluid stem cells 251
 bone marrow-derived stem cells 249
 muscle-derived stem cells 251
 synovium-derived stem cells 250
 mesenchymal tumors 367
 metabolites 147
 methacrylated gelatin 52
 methacrylated tropoelastin prepolymers
 55
 microencapsulation 561
 microfluidic bioreactors 174, 175
 microfluidic chips 154
 microfluidics and assist devices 403,
 404
 microfluidics-based biosensors
- integrated tissue scaffold 155
 microfluidic chips 154
 micromolded gelatin hydrogel 131
 micropattern-based techniques 333,
 334
 mind-controlled bionic prosthetic arms
 680
 mitogen-activated protein kinase
 (MAPK) 546
 mouse embryonic fibroblasts (MEFs)
 113
MRC5 lung fibroblasts 113
 MSC-laden polylactic acid micro
 carriers 529
 multi-functional skin models 223
 Murine *Nlx2-1* 401
 muscle-derived stem cells (MDSCs)
 251
 musculoskeletal tissue engineering
 acellular grafts 474
 allografts 475
 animal models 494
 autografts 474
 bioreactors 491
 clinical trials 497
 collagenous bioscaffolds 478
 growth factors 488, 490
 ligaments 470
 mesenchymal stem cells 485
 natural scaffolds 477, 478
 perfusion bioreactors 183
 rotating wall vessel bioreactors 179
 skeletal muscle 470, 471
 soft tissue injuries 465
 spinner flasks 182
 synthetic bioscaffolds 481
 tendon 467, 468
 tissue engineered
 tendon/ligament/muscle 466
 xenografts 474
 myocardial infarction (MI) 413
 myocardial tissue
 bioreactors 424, 427
 cell sheets 424, 427
 decellularized scaffolds 424, 426
 engineered cardiac tissues 428,
 429

- hydrogels 423, 424
prefabricated scaffolds 423, 424
myosin filaments 472
- n**
- nanocomposites 683
nanocomposite scaffold 375
nanofibrous scaffolds 112
biodegradation 627
characterization 628
self-assembling nanomaterials 628
nanoparticle delivery systems 539
nanostructured scaffolds 538
nano-tip FETs 153
nanowire field-effect transistors 150
nanowire nanoelectronic scaffolds (nanoES) 686
natural biomaterial-based scaffolds 131
natural biomaterials
agarose-based materials 621
alginic acid 50
alkaline and acid treatments 607
axonal injury 606
biocompatibility 605
chitosan 51
collagen 46, 48
collagen-based biomaterials 614
decellularization 606
elastin 55, 56
enzymatic decellularization 612
fibrin 53
force and pressure decellularization 612
gelatin 52
hyaluronan-based biomaterials 616
hyaluronic acid 47
hypotonic and hypertonic treatment 611
ionic detergent treatment 608
micro-patterning 605
non-ionic detergent treatment 608
non-thermal irreversible electroporation 612
peptides 54
plasticity 605
regeneration of neural tissue 606
silk 54
thermal decellularization 611
tri(n-butyl)phosphate treatment 611
Wallerian degeneration 605
zwitterionic detergent treatment 610
natural bioreactor 378
naturally derived biomaterials 527
natural proteins 340
natural scaffolds 477, 478
N-diazeniumdiolate 157
needle-type electrochemical glucose sensors 157
neonatal kidney cells (NKC)s 591
nephron 576, 577
nerve growth factor (NGF) 13
neural crest stem cells (NCSC) 132
neural progenitor cells (NPCs) 120
neural tissue engineering (NTE) 97, 132, 185
agarose-based materials 621
alkaline and acid treatments 607
biodegradation of scaffold 627
characterization 628
collagen-based biomaterials 614
enzymatic decellularization 612
fibrin-based biomaterials 619
force and pressure decellularization 612
hyaluronan-based biomaterials 616
hypotonic and hypertonic treatment 611
ionic detergent treatment 608
non-ionic detergent treatment 608
non-thermal irreversible electroporation 612
peptide-based biomaterials 625
poly (ethylene glycol) 624
poly (lactic-co-glycolic acid) 624
self-assembling nanomaterials 628
thermal decellularization 611
tri(n-butyl)phosphate treatment 611
zwitterionic detergent treatment 610
neuroepithelial cells 657
NeuroflexTM 614
neurogin 2 (Ngn2) 661

- N**
- NeuroMarixTM 614
 - NeuroMendTM 614
 - neuromuscular-electrode interface 679
 - neurotrophic factors 662
 - NeuroWrapTM 614
 - newborn BJ-1 foreskin fibroblasts 113
 - Nile blue chloride 149
 - nitric oxide (NO) 157
 - non-functioning larynx 369
 - non-inflammatory osteoarthritis (OA) 245
 - non-ionic detergent treatment 608
 - non-small cell lung cancers 393
 - non-thermal irreversible electroporation (NTIRE) 612
 - non-vascularized grafts 370
 - normoglycemia 555
 - nuclear matrix protein SATB2 125
- O**
- off-the-shelf engineered tissue 144
 - off-the-shelf graft 344
 - omentum flap 128
 - organic electronics
 - bionic tissues 681
 - mechanism 681
 - organotypic 3D spheroid culture system 230
 - organ printing 594
 - orthotopic liver transplantation 297
 - osteocalcin (OCN) 541
 - osteochondral defect model 49
 - osteochondral transplantation
 - techniques 246
 - osteocomductive scaffolds 121
 - osteocyte-osteoblast communication 541
 - osteogenesis 525
 - osteogenic progenitors 543
 - osteopontin (OPN) 541
 - oxygen-insensitive fluorophores 149
 - oxygen monitoring 148
 - oxygen-sensitive and oxygen-insensitive fluorophores 149
 - oxygen-sensitive luminophores 149
- P**
- packed bed bioreactor system 185
 - pancreas tissue engineering 18
 - pancreatic islet transplantation 555
 - paper-based microfluidics 154
 - parallel aligned poly(l-lactide-co-e-caprolactone) (PLLA-CL) nanofibers 337
 - parallel plates bioreactors 173
 - parathyroid hormone-related protein (PTHrP) 263
 - parenchymal fluid pressure (PFP) 313
 - patterned biomaterials 621
 - PCL-based spiral scaffolds 186
 - PepChip based strategies 531
 - peptide amphiphile (PA) 539
 - peptide-based biomaterials 625
 - peptides 54
 - microarrays of 531
 - perfusion bioreactors 177, 180, 183
 - fixed/packed-bed bioreactors 172, 174
 - hollow-fiber bioreactors 172, 173
 - parallel plates 173
 - periodontal ligament fibroblasts (PLFs) 488
 - periosteal progenitor cells (PPCs) 487
 - peripheral nerve regeneration 614
 - perlecan 541
 - PermaDermTM 228
 - personal glucose meter (PGM) 147
 - personalized medicine 20, 363
 - petacene 681
 - photopolymerizable PEG hydrogels 60
 - photopolymerizable polyethylene glycol (PEG) based hydrogels 39
 - physical decellularization
 - force and pressure decellularization 612
 - non-thermal irreversible electroporation 612
 - thermal decellularization 611
 - piezoelectrics 691
 - piezo-electric sensitive scaffolds 546
 - piggy Bac* transposons 89
 - pig islets 556, 557
 - pigmented TESs 224

- platelet rich plasma (PRP) 489
 pluripotent and induced pluripotent stem cells 456
 pluripotent stem cells 585
 embryonic stem cells 251
 induced pluripotent stem cells 252
 Pluronic F-127 (PF-127) 400
 Pluronic F127 polymer networks 693
 poloxamine 46
 poly(DL-lactic-*co*-glycolic acid) (PLGA) 17
 poly(ϵ -caprolactone) (PCL) 17, 58
 poly(ethylene glycol) (PEG) 49, 60, 259, 624
 poly(glycolic acid) (PGA) 17, 49
 poly(hydroxybutyrate-*co*-hydroxyvalerate) (PHBV) 222, 223
 poly(L-lactic acid) (PLLA) 17
 poly(L-lactic-*co*-glycolic acid) (PLGA) 377
 poly(lactic acid) (PLA) 57
 poly(lactic acid-*co*-glycolic acid) (PLGA) 47, 57, 59, 335, 624
 poly(N-isopropylacrylamide) (PNIPAAm) 55, 259
 poly(propylene fumarate) (PPF) 17
 poly(vinyl alcohol) (PVA) 61
 poly(lactic-*co*-glycolic) acid microspheres 156
 polyacrylamide hydrogels 128
 polyanhydrides 17
 polycaprolactone (PCL)
 based scaffold 337
 electrospun nanofibrous scaffolds 112
 poly(ethylene glycol)diacrylate (PEG-DA) 487
 poly(dimethylsiloxane)-encapsulated silica gel particles 149
 polyester 258
 polyethylene glycol (PEG) 148
 polyglycolic acid (PGA) 177, 400
 polyglycolic acid (PGA) scaffold 6
 polyhydroxyesters 481
 polylactic acid (PLA) 49
 poly-lactic-*co*-glycolic acid (PLGA) 399
 poly-L-lactic-acid (PLLA) 177, 399
 poly-L-lysine (PLL) 335
 polymeric microspheres 156
 polymeric scaffold approaches
 lung parenchyma engineering 399
 tissue engineered trachea 397, 398
 vascularization 400
 polymeric scaffolds
 biological sources 451
 synthetic sources 450
 polymerized tropomyosin 472
 polymer tissue scaffolds 677
 poly(lactic-*co*-glycolic acid) (PLGA)
 nanofibers 120
 polyorthoester (POE) 17
 polysaccharide-based scaffolds 452
 poly(vinylidene fluoride)
 trifluoroethylene) (PVDF-TrFE)
 scaffold 426
 polyurethane (PU) 259
 polyvinyl chloride (PVC) 148
 porous NF poly-L-lactide (PLLA)
 scaffold 120
 porous scaffolds 117
 porous templated scaffolds 158
 porous titanium prosthesis 372
 prefabricated scaffolds 424
 prevascularization-based techniques
 in vitro prevascularization 332
 in vivo prevascularization 331
 primary malignant tumors 367
 primordial germ cells 89
 ProNectin 186
 prostate specific antigen (PSA) 146
 protein-based scaffolds 453
 protein kinase (PK) signaling 545
 protein tyrosine phosphatase 531
 proteoglycans 244, 467
 pulmonary tissue engineering
 cellular and drug delivery 407
 cellular source 405
 decellularized tissue approach 400,
 402
 dimensional printing 403
 exogenous stem cell therapy 406
 lung cancer 392
 lung parenchyma engineering 399

- pulmonary tissue engineering (*contd.*)
 microfluidics and assist devices 403,
 404
 obstructive pulmonary disorders
 391
 restrictive lung disease 390
 structure-function relationship 394,
 396
 tissue engineered trachea 397, 398
 treatment options 393
 vascularization 400
- r**
 radial flow bioreactors 177
 RANK/RANKL/OPG pathway 540
 rapid prototyping 64
 rat multipotent adult progenitor cells
 (ratMAPC) 176
 reactive oxygen species (ROS) 149
 recellularization of acellular renal
 sections 592
 recellularization of whole kidney
 scaffolds 591
 recombinant BMP-7 (rhBMP-7) 531
 regenerative medicine, *see also* tissue
 engineering
 clinical need 4
 history 5
vs. tissue engineering 6
 renal allotransplantation 575
 renal tissues
 bio-scaffold based technologies, (*see*
 bio-scaffold based technologies)
 early kidney development 578, 579
 embryonic kidney cells 582, 585
 glomerular filtration barrier 579,
 580
 kidney vascularization 580
 nephron 576, 577
 pluripotent stem cells 585
 renal anatomy 576
 renal functions 577
 tissue-based strategies 581
 resident cardiac stem cells (CSC) 422
 resident neural stem cells 657
 RESTORE™ 475
 restrictive lung disease 390
- retinal implants 679
 retinoid acid (RA) treatment 120
 Rho-associated kinase (ROCK) inhibitor
 583
 rotating bed bioreactors (RBS) 172,
 179
 rotating wall vessel bioreactors 172,
 176, 179
 $\text{Ru}_2(\text{Ph}_2\text{phen}_3)\text{Cl}_2$ 149
- s**
 sarcoplasmic reticulum (SR) 473
 scaffold-based tissue engineering 116
 scaffold based treatment 664
 scaffold-free cartilage tissue engineering
 270, 272
 scaffold requirements for specific tissues
 44
 scaffolds 111
 and biomaterials 526
 stiffness characteristics 665
 structure design and fabrication
 techniques 336, 338
 Schwann cells 224
 sclerostin 542
 secondary malignant tumors 368
 self-assembling nanomaterials 628
 self-assembling proteins (SAP) 539
 semiconductor nanowires (NWs) 685
 sendai virus 89
 serum free floating culture of embryoid
 body-like aggregate with quick
 reaggregation (SFEBq) 669
 sheep mesenchymal stem cells (shMSC)
 184
 silicon nanowire nanoelectronics 685
 silicon nanowires 152
 silk 54
 silk based scaffolds 123
 single cassette reprogramming vector
 114
 skeletal muscle 470, 471
 skin equivalents (SE) 19
 skin grafting 217
 skin grafts 218
 skin-humanized small animal models
 230

- skin tissue engineering 131
sliding filament theory of muscle contraction 472
small-cell lung cancer 393
small diameter vascular grafts 344
smart biomaterials 10
smart scaffold design 527
smooth muscle cells (SMCs) 120
S-nitrosothiol-modified silica nanoparticles 157
soft tissue injuries 465
solid free-form fabrication (SFF) 63
solid-state nanomaterials nanocomposites 683
silicon nanowire nanoelectronics 685
sonic hedgehog homolog (SHH) 334
specialized neurospheres 99
spinner flasks 171, 172, 176, 182
squamous cell carcinomas 367
starch 604
STAT3 88
stem cells bone tissue engineering 92, 93, 96
cardiac tissue engineering 97
cartilage tissue engineering 96 challenges and future directions 101
embryonic 88
hematopoietic 91
induced pluripotent 89
mesenchymal 91
neural tissue engineering 97
skin, liver, lungs, bladder and pancreas 99
tissue engineering 86
unique properties 86
Wharton's jelly 92
StemFit 115
stirred bioreactors 186
Stryker Orthopaedics 473
syngeneic iPSCs 116
synovium 250
synovium-derived stem cells (SDSCs) 250
synthetic biomaterials peptide-based biomaterials 625
poly(ϵ -caprolactone) 58
poly(ethylene glycol) 60, 624
poly(lactic acid) 57
poly(lactic acid-co-glycolic acid) 57, 59
poly(lactic-co-glycolic acid) 624
poly(N-isopropylacrylamide) 55
poly(vinyl alcohol) 61
synthetic bioscaffolds 481
synthetic degradable polymers 488
synthetic hydrogels 423
synthetic materials 527
synthetic polymers 538
synthetic tendon, ligament and skeletal muscle bioscaffolds electrospinning 482, 483
knitting 484
micropatterning 484
use 486
- t**
- tail-tip fibroblasts (TTF) 113
templated porous scaffolds 157
templated scaffolds 621
tenascin-C 467
tendon 467, 468
tendon stem cells (TSCs) 487
teratoma 101
testicle tissue engineering 18
TGF- β 3-adsorbed acellular scaffold 272
thermal decellularization 611
thirty five-micrometer porous templated scaffolds 158
3D bio-printing materials 536
scaffold-building substances 537
typical process 535
3D ECM scaffolds 121
3D fibronectin-coated PLGA scaffolds 58
3D galactosylated silk fibroin scaffolds 54
three-dimensional macroporous nanowire nanoelectronic scaffold 153
3-dimensional (3D) vascularized multicellular tissues 6

- 3D PCL/gelatin scaffolds 118
 3D porous alginate sponges 50
 3D-shaped osteochondral tissues 529
 thyroid cartilage 364
 tissue-based strategies 581
 tissue culture polystyrene (TCP) culture 174
 tissue-engineered blood vessels
 bioactive material-based techniques 338, 339
 cell co-culture-based techniques 335, 336
 functions 326
 growth factor-based techniques 333
 micropattern-based techniques 333, 334
 scaffold-structure design and fabrication techniques 336, 338
 structure and component 326, 327
 vascular replacement grafts 340
 vasculogenesis and angiogenesis 329
in vitro prevascularization 332
in vivo prevascularization 331
 tissue engineered heart valve (TEHV)
 fabrication 445
 tissue engineered skin substitutes (TESs)
 acute and chronic cutaneous wounds 218
 autografts 217
 bilayered models 221
 cadaveric allografts 217
 cultured keratinocytes 233
 cytokines/immobilized peptides 234
 dermal models 221
 dermal substitutes 227
 dermo-epidermal skin substitutes 228
 epidermal models 220
 epidermal skin regeneration 226
 functional skin 233
 heterologous cells 234
 melanocytes 219
 multi-functional skin models 223
 natural biomacromolecules 219
 skin appendages 219
 skin grafting 217
 skin structure 218
 3D matrix/scaffold 219
 types of different skin grafts 218
 vascularized extracellular matrix 217
in vitro wound healing models 231
in vivo wound healing applications 230
 tissue engineered tendon/ligament/muscle 466
 tissue engineered trachea 397, 398
 tissue engineered vascular grafts (TEVG) 44
 tissue engineering
 approach 8, 9
 biomaterials and scaffold production 10
 cell signaling research and bioreactor development 11, 12
 cell sourcing and cell manipulation 10
 challenges 21
 clinical need 4
 complex tissues and organs 13
 description 3
 future of 22
 history 5
 implantable organs 15
 limited donor availability 3
 vs. regenerative medicine 6
 smart diagnosis and personalized medicine 20
 triad of 7
 in vitro models for disease studies 19
 TissueMendTM 473
 TNF-stimulated gene 6 protein (TSG-6) 661
 total pharyngolaryngectomy 382
 trachea 365
 tracheal allografts 369
 tracheal allotransplantations 374
 tracheal/laryngeal resections
 benign tumors 367
 benign tumors of larynx 368
 cancer of larynx/hypopharynx 368
 laryngotracheal stenosis 366

- non-functioning larynx 369
 - primary malignant tumors 367
 - secondary malignant tumors 368
 - tracheal replacement 374
 - tracheal scaffolds 398
 - tracheal transplantation and autografts 370
 - trachea tissue engineering 376
 - Transcyte® 221
 - Transcyte™ 227
 - transforming growth factor-1 (TGF-1) 52
 - transforming growth factor β (TGF- β) 13, 118, 262
 - traumatic brain injury (TBI)
 - astrocytes 656
 - biologics and drug-based treatment 667
 - cell based and neuroprotection
 - therapeutic strategies 658, 659
 - death rates 655
 - glial cells 656
 - glial scar 657
 - inflammation 656
 - microglial cells 657
 - neuro-tissue engineering 670
 - oligodendrocytes 656
 - pathophysiology 656
 - peripheral nervous system 655
 - primary brain injury 656
 - resident neural stem cells 657
 - scaffold based treatment 664
 - scar tissue formation 669
 - translational approaches 668
 - tri(n-butyl)phosphate treatment 611
 - TritonX-100 589
 - tubular scaffold fabrication 342, 343
 - tumor necrosis factors-alpha (TNF- α) 225
 - type-2 cyclooxygenase (COX-2) 542
 - type I collagen 47
 - type I-III collagen bilayer gels 46
 - type II pneumocytes 397
 - type I pneumocytes 397
 - type VI collagen 47
 - type X collagen 250
- u**
- umbilical cord-derived cells 455
- v**
- valvular bioengineering
 - cells derived from vasculature 455
 - stem cells 455
 - umbilical cord-derived cells 455
 - valvular interstitial cells (IC) 446
 - vascular endothelial growth factor (VEGF) 329, 580
 - vascular engineering 90
 - vascularization 400
 - vascular replacement grafts
 - material selection 340
 - requirements 340
 - tubular scaffold fabrication 342, 343
 - vasculo-and osteogenic cells 543
 - vasculogenesis and angiogenesis 329
 - vasculogenic progenitors 543
- w**
- Wallerian degeneration 605
 - water-soluble CdSe/CdS semiconductor tetrapod nanocrystals 150
 - wave bioreactors 172, 173
 - wavy-walled bioreactor (WWB) 171
 - Wharton's jelly stem cell (WJSCs) 92
 - whole organ pancreas transplantation 554
 - Wilms tumor 1 (WT1) 582
- x**
- xenografts 474
 - xenotransplantation 556
- y**
- Yamanaka factors 113
- z**
- zwitterionic detergent treatment 610
 - zwitterionic hydrogels 156

