

# Index

## A

Absorption, vi, 4, 5, 7, 11–13, 20, 21, 64, 95, 108–111, 113–116, 118, 123, 132, 214  
*Acanthocnemus nigricans*, 4, 6–10  
Adaptability, 119, 206, 215, 216  
Adaptations, vi, 6, 8, 94, 95, 97–101, 103, 114, 115, 119, 180  
Adhesion, v, vii, 30, 37, 122–129, 132–134, 180, 194, 200, 206, 207, 215–217  
Adhesive, vii, viii, 30, 39, 122, 125, 132, 143, 149–151, 153, 154, 163, 165–168, 170, 172, 175, 176, 180, 193, 195–197, 199, 200, 202, 206–208, 215–217  
Adhesiveness, 30, 39, 178, 206  
Adsorption, 48, 122–129, 132–134  
Adsorption hypothesis, 123  
Aeration cells, 117, 118  
Aerial roots, vi, 108–113, 115–118  
Algae, 62, 110, 111  
Alytidae, 208, 217  
Anatomy, 145, 170, 174, 177, 206, 207, 214  
Antagonistic, 194  
Antibacterial, 39, 95  
Antifouling, 32  
Antireflection, 30–34, 36–38  
Anti-wetting, 30, 37–39, 48  
Anura, 206, 207  
Arachnida, 170  
*Arachnocampa luminosa*, 153, 163–166  
*Aradus albicornis*, 17, 18  
*Aradus flavicornis*, 17  
*Aradus fuscicornis*, 17  
*Aradus lugubris*, 17  
Arid, vi, 95, 102  
Armor, 229, 242

Arthropod, vi, 30–33, 35–39, 41, 42, 44–46, 48, 60, 149, 250  
Asperities, 123, 215  
Asymmetric capillaries, 101  
Asymmetric transport, *see* Passive transport  
Atomic force microscopy (AFM), 30, 41, 44, 45  
Attachment, vii, 12, 21, 39, 47, 108, 116, 122, 123, 132, 145, 160, 165, 176, 179, 194, 195, 198, 200, 201, 207, 215, 239, 250, 256  
Autofluorescence, 250–252, 255, 258

## B

Bannerfish, 235–238, 240  
Base, viii, 17, 125, 128–130, 132, 134, 135, 157, 251, 258, 259  
Beetle, vi–viii, 4, 6–11, 13, 14, 16, 18–21, 34, 38, 55, 60, 62–65, 72, 73, 75, 79, 80, 123, 125, 132, 133, 149, 165, 193, 195–197, 199, 200, 202, 207, 248, 250, 251, 253–255, 257–260  
Bioadhesives, 142–145, 147, 149, 150, 152–155, 157, 158, 160–162, 165, 167, 168, 170–172, 174–176, 178–180  
Bioengineering, vi, 48  
Bio-inspired, *see* Biomimetics  
Biomechanical, 175, 194, 207, 248  
Biomechanics, viii, 248  
Biomimetics, v, vi, 31, 32, 48, 103, 202  
Block copolymer, 42, 43, 46, 47  
Bluegill, 228, 231, 232, 235–238, 240, 241  
Bolometer, 4, 6–12, 14, 16, 18–21  
*Bombina variegata*, 208–217

Bombinatoridae, 208, 217  
 Bones, 154, 224, 225, 230, 231  
 Boundary layer, 230, 239–242  
 Bragg stacks, 59, 62, 79  
 Breeding, 10, 13  
*Bufo bufo*, 206, 208–217  
 Bufonidae, 207, 208, 217  
 Burnt wood, 17, 19

## C

Camouflage, 36, 54, 60, 70, 75, 80, 94, 142  
 Capillarity, 118, 194  
 Capillary, vi, 101–103, 132  
 Carbohydrate, 160, 179  
 Carbon dioxide (CO<sub>2</sub>), 113, 114  
 Cassidinae, viii, 248, 258  
 Cassie's law, 99, 100  
 Ceiling, vii, 167, 193–195, 197, 199, 200, 202  
 Cell walls, 39, 63, 64, 69, 70, 108, 109, 113, 115–117, 119  
 Centipedes, vii, 41, 143, 144, 147, 149, 153  
 Ceratophryidae, 208  
*Ceratophrys ornata*, 206–210, 212–217  
 Channels, vi, 8, 43, 66, 98, 101–103, 161, 173, 174, 251, 255, 256, 258, 260  
 Chilopoda, 143, 144, 146  
 Chirality, 71  
 Chrysomelidae, 258  
 Circular polarisation, 64, 71  
 Climbing, 193, 200, 202  
*Coccinella septempunctata*, 123, 132, 194, 195, 199  
 Coherence (light), 54, 57, 58  
 Colloblasts, 168–170  
 Colour mixing, 54, 79  
 Complex photonics, 53  
 Condensation, vi, 95, 100, 159  
 Cone cells, 30, 40, 42, 44–47  
 Confocal laser scanning microscopy, 250–252, 258  
 Contact, vii, 18, 97, 101, 116, 119, 122, 132, 134, 149, 154, 168, 194, 196–201, 206, 215, 231, 233, 248, 250, 251, 253–260  
 Contact angle, 37, 38, 98–101, 123, 125, 126, 134  
 Copulation, viii, 10, 17, 248, 249  
 Cornea, vi, 30–34, 36–40, 42, 44–47  
 Cortex, 108–110, 115–118  
 Crassulacean acid metabolism (CAM), 114  
 Crenate, viii, 225, 226  
 Cryo scanning electron microscopy (cryo SEM), vii, 124, 126, 133

Crystallography, 56, 57  
 Ctenii, viii, 225–230, 232, 237, 238, 242  
 Ctenoid, viii, 226–228  
 Cuticle, v, 4–11, 13, 14, 16, 17, 19–21, 30, 38, 46, 55, 60, 61, 63, 64, 75, 113, 124, 126, 144, 145, 173, 174, 178, 250, 255  
 Cycloid, viii, 225, 226, 237

## D

Defence, vii, 142–144, 147, 149–151, 153–155, 157–159, 161, 162, 165, 167, 169, 170, 172, 174–176, 178, 180  
 Dehydration, 110, 112, 114, 117, 118, 208, 230  
 Dendrobatidae, 208, 217  
 Dermis, 98, 223, 224, 231, 232  
 Deserts, 94–96, 101  
 Detachment, 122, 197, 198, 200, 201  
 Developments, v, vi, 20, 32, 42, 44, 45, 53, 60, 65, 115, 144, 155, 158–160, 162, 169, 170, 225, 227, 239  
 Dew, 95, 108, 118  
 Diamond lattice, 70  
 Diffraction gratings, 77  
 Diptera, 6, 35, 41, 171  
 Directional transport, *see* Passive transport  
*Discoglossus pictus*, 208–217  
 Disordered nanophotonics, 58, 82  
 Disordered nanostructures, 36, 54, 67  
 Distribution, 4, 10, 45, 56, 72, 75–77, 79, 151, 166, 200, 215, 236, 250, 253  
 Diversity, v–viii, 30, 32–34, 36–39, 41, 42, 44–46, 61, 65, 68, 77, 94, 118, 193, 206, 207, 216, 217, 225–227, 229, 230, 237, 241, 248  
 Drinking, 95, 96, 98, 101  
 Drop behavior, vii, 125, 127, 130, 132, 134  
 Drops, vii, 38, 39, 124–132, 134, 135, 144, 145, 237  
*Drosophila*, 31, 38, 44–46, 48

## E

Elasmoid, 224, 225  
 Epicuticular wax, vii, 122, 123, 125–128, 131, 132, 134, 135  
 Epidermis, viii, 60, 64, 143, 145–148, 151, 155, 156, 168, 223–225, 230, 231, 236–238, 241  
 Epiphytic orchids, vi, 108, 109, 113, 118  
 Epithelium, 78, 142, 144, 155, 157, 173, 208

Epivelamen, 110, 115, 116  
 Evaporation, 95, 101, 108, 111, 115, 116, 118, 129, 131, 132  
 Evolution, viii, 4, 6, 13, 20, 34, 41, 54, 70, 77, 94, 109, 118, 144, 180, 217, 227, 230, 241, 248, 258  
 Exodermis, 108–110, 116–118  
 Exponentials, 56, 125, 128–131, 135, 259  
 Extrusions, 162, 216  
 Eye, vi, 10, 30–34, 36–40, 42, 44–46, 62, 66, 67, 78, 153

**F**

Feeding, 6, 10, 17, 95, 154, 175, 206, 207, 215, 216  
 Fibrils, 63, 66, 115, 144, 206  
 Filiform papillae, 206, 207, 209–212, 214–217  
 Fire detection, 10, 19  
 Fish, viii, 5, 60, 153, 155, 223–242  
 Flagellum, 249, 250, 252–260  
 Fluid handling, vii, 14, 19, 101, 102, 123, 126, 132–134, 150, 161, 229, 239  
 Fog, 38, 108  
 Force, vii, 20, 30, 38, 42, 43, 101, 123, 167, 175, 178, 194, 199, 200, 206, 215, 216, 229, 257, 259, 260  
 Forest fires, v, 3–5, 7, 8, 11, 16, 19  
 Fourier transform, 35, 55, 56, 67, 68, 72  
 Friction, v, viii, 65, 200, 215, 217, 230, 239  
 Frogs, vii, 94, 142, 153, 180, 206–211, 215, 216  
 Functional morphology, 143, 238, 252, 258

**G**

Gas exchange, vi, 108–110, 112–117, 119  
 Geckos, 30, 194, 207, 216  
 Gel-based profilometry, viii, 226, 233, 234, 236, 239, 241  
 Genetics, 31, 44–46, 48  
 Genitalia, viii, 248, 250, 257  
 Geophilomorpha, 143–147, 149  
 Gland mucus cells (GMC), 155, 156, 160, 162  
 Glowworm, vii, 153, 163–167, 178  
 Glue gland (GG), 172–174, 180  
 Goblet cells, 157, 224, 231  
 Gradients, viii, 33, 34, 114, 124, 207, 216, 237, 248–251, 253–255, 257–260  
 Grasshoppers, 207, 216  
 Groinoids, 43, 71

**H**

Hagfish, vii, 153, 155, 157, 159, 160, 162  
 Hairy, 193, 195, 202, 256  
 Height, 30, 34, 37, 38, 41, 47, 63, 77, 125–130, 134, 135, 196, 208, 236, 237, 239, 240  
 Helicoids, 62–65  
*Henia vesuviana*, 146, 148, 149  
 Hierarchical organization, vi, 53, 75, 77, 215  
 High-speed camera, 196  
 High-speed video recordings, vii, 194  
 Histology, 216, 217, 224, 230–232, 234, 236  
 Horned frogs, 206  
 Hybrid adhesive, 202  
 Hydrodynamics, viii, 225, 229, 230, 234, 238, 241, 242  
 Hydrophilic, 47, 98, 99, 153  
 Hylidae, 208  
 Hypothesis, 40, 99, 100, 122, 153, 157, 160, 180, 200, 215, 216, 250, 256, 257

**I**

Image processing, 198, 251  
 Imbibition, 132  
 Index matching, 74  
 Infrared (IR)  
   radiation, 4–6, 9, 11, 12, 14, 20  
   receptor, v, 3–5, 7, 8, 10, 11, 13, 14, 16–21  
   sensillum, 7, 8, 15, 17, 18, 20, 21  
   sensitivity, 3, 11, 14, 16, 20  
 Insect attachment, 122, 123, 132  
 Insects, v–vii, 3, 4, 6–12, 14–17, 19, 20, 30–32, 34–38, 40, 41, 45, 65, 95, 122, 123, 125–129, 132–135, 143, 164, 165, 193–195, 200, 249, 258  
 Insertion, 15, 18, 257  
 Integument, vi, 30–32, 94, 95, 97–99, 101–103, 157  
 Interaction, vii, viii, 5, 30, 33, 37, 39, 40, 42–44, 47, 54, 74, 122, 179, 196, 206, 215, 225, 230, 234, 238, 239, 241, 242, 248, 249, 258  
 Interconnection, 7, 42, 98, 101–103, 157, 158  
 Interference, 54, 57, 58, 63, 67, 77, 172  
 Interspecific variation, 209, 212, 214, 217  
 Invertebrates, 143, 175, 248  
 Iridescence, 54, 59, 66, 68, 76

**K**

k+, 239–242  
 Kinematics, 229, 239, 248

**L**

Lacunae, 74, 211, 213, 214, 216  
 Laminar flow, 230  
 Laplace's law, 101  
 Leaf beetles, 258  
 Leafless orchids, 110, 113–119  
 Lectin, 153, 160  
 Lens, 30, 32, 36–38, 40–42, 45–47, 196, 258  
 Light, vi, viii, 5, 11, 32–37, 47, 54, 56–59, 61–65, 69, 70, 72–77, 80–82, 117, 133, 134, 158, 160, 165, 171, 177, 207, 217, 258  
 Light diffusion, vi  
 Linear dependence, 125  
 Liquid, 16, 37, 39, 40, 43, 98, 99, 101–103, 132, 134, 172, 260  
 Liquid diode, *see* microfluidic diode  
 Lissamphibia, 206  
*Litoria*, 207–209, 211, 215–217  
*Litoria infrafrenata*, 207, 210, 212–214  
 Lizard, 94–103  
 Locomotion, vii, 122, 144, 194, 196, 199, 200, 202, 230  
 Log-linear, 128–130, 135  
 Log-log, 128–130, 135  
 Longitudinal asymmetry, 101, 102  
 Lower wax layer, 124, 131

**M**

Magnetic Resonance Imaging (MRI), 110–112  
 Material composition gradient, viii, 255  
 Matrix, 134, 145, 148, 209, 210  
 Mechanical properties, vii, viii, 13, 161, 166, 167, 207, 258  
 Mechanical stability, 216  
 Mechanoreceptors, 7, 11, 14, 17, 18, 20, 21  
 Megophryidae, 208  
*Megophrys nasuta*, 208–217  
*Melanophila acuminata*, 15  
*Melanophila consputa*, 14  
 Meniscus, 101  
*Merimna atrata*, 4, 6, 7, 10–12  
 Micro x-ray computed tomography ( $\mu$ CT), 230–232  
 Micro-channel, vi, 98, 102  
 Micro-computed tomography (micro-CT), 207–209, 211, 213, 214, 216  
 Microfluidic diode, 16, 18, 19  
 Micro-ridges, 212, 215, 217  
 Microstructures, v, vi, viii, 11, 12, 21, 38, 97–100, 102, 202, 206–211, 213–217, 227, 230, 237, 242  
 Microvilli, 40, 42, 44–47, 145, 146, 173, 178

Mitochondria-rich zone, 157, 158, 160  
 Modelling (photonics), 66, 67  
 Moisture, vi, 17, 95–98, 100–102  
 Moisture-harvesting behavior, 96, 97  
 Molecular mechanism, 21, 48  
*Moloch horridus*, 95–97, 101  
 Moonys, 235–238, 240  
 Morphology, 9, 15, 37, 38, 72, 122, 123, 142, 160, 168, 174, 180, 225, 227, 229–232, 238, 239, 241, 242  
 Moth-eye, 31  
 Mucus, vii, viii, 142, 154, 156, 157, 163, 167, 206, 215, 223–232, 236–242  
 Multilayer, 55, 58–62, 66, 76–80  
 Multiple scattering, 72, 75  
 Multipolar neuron, 11, 12  
 Musculature, 211, 214, 216  
*Myxine glutinosa*, 156, 158–162

**N**

Nanocoatings, vi, 30, 32–34, 36–38, 40, 41, 43–45, 47  
 Nanopatterns, 40–42, 44, 47  
 Nanostructures, vi, 30, 31, 33–41, 43–48, 53, 54, 62, 67, 76, 77  
*Nepenthes alata*, vii, 123, 124, 126, 129, 132, 133  
 Numerical, vii, viii, 33, 54, 60, 70, 73, 134, 135, 248, 250, 258–260  
 Numerical simulation, viii, 250, 251, 253–256  
 Nutrients, 108–110, 113, 116

**O**

Oberhäutchen, 97–100  
 Oil, v, vii, 14, 16, 39, 43, 122–135  
 One-layered, 127, 130, 132  
 Onychophora, 175–180  
*Oophaga histrionica*, 208–217  
 Open microfluidics, 103  
 Optical properties, viii, 32–35, 37, 230, 233  
 Orb-web spiders, 161, 163, 164, 166, 170, 171, 178  
 Orchids, vi, 109, 110, 112–114, 116–119  
 Orders, vii, 6, 11, 30, 34–36, 41–42, 44, 46, 47, 54–58, 60–70, 72–77, 79, 80, 82, 175, 193, 194, 196, 198, 200, 239, 242, 250

**P**

Papillae, viii, 175, 176, 206, 207, 209–217  
 Passage cells, 116–118

- Passive transport, 102
- Pattern, 9, 31, 35–37, 40–42, 44, 46–47, 62, 63, 66, 69, 70, 98, 142, 150, 170–172, 178–180, 199, 207, 209, 225, 227, 229, 230, 233, 236–238, 240–242
- Peeling, 194
- Penetration, 13, 21, 248, 252, 257
- Penis, viii, 248, 249, 251, 253–255, 257–260
- Periodicity, 43, 54–56, 60, 62, 68, 70, 72
- Permeability, 108, 113–115, 118
- Photomechanic principle, 4, 6
- Photonic crystals, 61, 66, 67, 69, 70
- Photosynthesis, 61, 109, 110, 113, 114
- Phrynosoma cornutum*, 96, 97, 99, 101
- Phylogeny, 180, 217, 242
- Pitcher, vii, 122–124, 126, 127, 129–133
- Pixellated surfaces, 75, 78, 80, 81
- Plethodon shermani*, 150–153
- Pleurobrachia pileus*, 167–169
- Pneumathodes, 110, 116, 117
- Polycrystallinity, 70, 71
- Porous material, vi, 109, 132
- Power-law, 125, 127, 128, 131, 135, 239
- Predation, vii, 94, 142–145, 147, 149–151, 153–155, 157, 158, 160, 161, 163–166, 168–171, 173–176, 178, 180
- Pre-wetting, 99, 100
- Prey trap, 172
- Principapillatus hitoyensis*, 176
- Profilometry, viii, 226, 230, 231, 233, 234, 236, 240, 241
- Protein, 7, 20, 30, 32, 47, 146, 149, 152, 157, 160, 162, 170, 173, 178–180, 256
- Protraction, 207
- Protrusions, 30, 34–36, 38–40, 209, 217
- Pull-off forces, vii, 194, 200
- Pyrophilous behaviour, 4, 8, 13, 16, 17
- Pyrophilous insect, v, 4, 6, 7, 16, 18, 19
- R**
- Radii, viii, 169, 227–232
- Rain, 73, 74, 94–96, 108, 118
- Rana*, 206–217
- Ranidae, 208
- Reaction-diffusion, vi, 40, 42, 44, 46, 47
- Reflection contrast, 35, 59, 62, 80
- Refractive index, 32–34, 55, 58, 60–63, 72, 74, 75
- Reptiles, vi, 94–101, 103, 143, 168, 193
- Resilin, 256
- Retraction, 207, 215
- Reynolds number, 239
- Roughness, 37, 98, 99, 122, 231, 233, 234, 236–239, 241
- S**
- Salamanders, vii, 149–154, 180
- SAXS, *see* Small-angle X-ray scattering (SAXS)
- Scale, vi, viii, 30, 40, 48, 58, 61, 64, 71, 75, 76, 79–82, 97–100, 135, 177, 179, 195, 197, 198, 210–212, 217, 224–232, 237–242
- Scanning electron microscopy (SEM), 12, 15, 18, 30, 41, 42, 46, 79–81, 100, 108, 109, 115, 116, 126, 207, 208, 210, 212, 228, 230–232, 234, 236
- Scat, 235, 237, 238, 240
- Scattering mean free path, 73
- Scytodes thoracica*, 171–174
- Sea gooseberry, 167, 168
- Seed dispersal, 54
- Self-cleaning, 32, 37–39, 95
- Self-organization, 46
- Setae, vii, 170, 171, 193, 194, 196–200, 202, 250
- Sexes, viii, 8, 248
- Short cells, 145
- Short-range order, 72
- Silk, 163–166, 172, 178
- Skin, vi, viii, 94, 95, 98, 100, 101, 150, 151, 153, 180, 223–225, 227, 230, 233, 236–242
- See also* Integument
- Slime, 153–157, 160–162, 175–179
- Slime thread, 153–157, 160–162, 175–179
- Small-angle X-ray scattering (SAXS), 56, 72
- Smoke, 17
- Smooth solid sample, 123, 124, 126–129, 131, 133
- Snakes, 95–97, 103, 150, 153
- Spatula, 194, 200, 202
- Spermatheca, 251
- Spermathecal duct, 248, 250–260
- Spines, viii, 142, 225–229, 237, 241, 242
- Spinoid, viii, 226, 227, 229
- Spitting spiders, 170, 171, 173, 175
- Spreading, 37, 100–102, 125, 126, 129, 130, 132
- Sternal glands, 143–147, 149
- Stiffness, viii, 207, 216, 229, 248, 250, 251, 253–260
- Stretch receptor, 7
- Structural colour, 58, 62, 64, 66, 67

- Structure factor, 56, 57  
 Substrates, vii, 34, 43, 98–100, 114, 123, 132, 193, 194, 200  
 Subsurface, 207, 211, 216, 217  
 Surface  
   disorder, 56  
   profile, 207, 214, 216  
 Swimming, 167, 224, 225, 229, 236, 238–240, 242  
 Synapomorphy, 217  
 Synthetic biology, 48
- T**  
 Tarsal, vii, 193, 194, 196, 197, 199, 200, 202  
 Tarsomeres, 195, 200  
 Technical applications, 103  
 Telopodal glands, 143, 146  
 Tentilla, 168, 170  
 Texas horned lizard, *see Phrynosoma cornutum*  
 Thermal receptor, 6  
 Thermoreceptors, 21  
 Thorny devil, *see Moloch horridus*  
 Threads, 122, 146, 153–162, 164–168, 171, 172, 175, 176, 178, 179  
 Three-dimensional, vii, viii, 12, 58, 70–72, 122–128, 131–133, 135, 207, 208, 211, 213, 214, 217, 230–234, 241  
 Time-dependant, 126, 128–130, 135  
 Time-dependence, *see* Time-dependant  
 Tissue, vi, 62, 64, 74, 108, 151, 152, 155, 157, 161, 175, 177, 178, 207, 208, 211, 213, 214, 216, 217, 225, 228, 230–232, 242  
 Tongue, vii, viii, 168, 206–217  
 Topography, 43, 44, 46, 225, 230, 233, 234, 236–239, 241, 242  
 Tortoises, 95–97  
 Transmission, 14, 34, 36, 56, 65, 178  
 Transport, *see* Passive transport  
 Triggerfish, 235–238, 240–242  
 Tripod gait, 199  
 Trout, 224, 232, 235–238, 240, 242
- Turing, 40–42, 44, 46, 47  
 Two-layered, 123, 124, 127, 129, 132, 133, 167
- U**  
 U-cells, 116–118  
 Upper wax layer, 124, 133
- V**  
 van der Waals, 194  
 Vascular cylinder, 108, 211  
 Velamen radicum (VR), vi, 108, 110, 112–114, 116, 118, 119  
 Velvet worms, vii, 175, 176, 178, 179  
 Vertebrates, 10, 143, 180, 215, 223, 248, 258  
 Video recordings, vii, 134  
 Viscosity, 133, 161, 215, 239  
 Visualization, vii, 194, 196, 198–200, 202, 209  
 Volume, 13, 21, 41, 113, 117, 125–132, 134, 135, 154, 231  
 VR, *see* Velamen radicum (VR)
- W**  
 Washburn's law, 102  
 Water, v–vii, 20, 30, 38, 39, 43, 58, 60, 74, 94–103, 108–116, 118, 123, 125, 126, 129, 130, 134, 153–155, 161–163, 166, 167, 175, 179, 208, 209, 225, 227, 238, 242  
 Water absorption, vi, 20, 108–110, 112, 114–119  
 Wax coverage, vii, 122, 123, 125–128, 131, 133, 134  
 Wettability, vi, 37, 98–100, 129, 153  
 Wetting, 37, 99, 100, 110, 111, 116, 132  
 Whiteness, 54, 73, 74, 79  
 Wide-angle X-ray scattering (WAXS), 56
- Y**  
 Yellow tang, 232, 235–237, 240–242