

Index

- accumulation method. See elective culture
 acidophile, 5
 actin, 103
 Actinobacteria, 51
 Adler, Julius, 190
 aerotactic, 30
 agar-agar, 70
 Age of Bacteria, 8
 ageing, 58
 algae, 2, 17, 19, 168
 amoebae, 121
 anaerobic respiration, 5, 18
 animal. See metazoan
 animal paradigm, 37
 animalcule, 60, 65, 175
 anthropocentrism, 90, 200, 202
 antibiotics, 89, 105, 123, 136, 171–2
 evolution of resistance, 171
 for signalling, 172
 aphid, 107
 apoptosis, 120, 180
 archaea, 2, 19, 52–3, 139
 archaeobacteria. See archaea
 Aristotle, 208
 Arrhenius, Olof, 162
Aspergillus fumigatus, 110
 astrobiology, 210
 autocatalysis, 209
 autotrophy, 5, 19, 185
- Baas Becking, Lourens G.M., 84, 136, 138–9, 164
Bacillus subtilis, 121–3
 bacteriophage. See phage
Bacterium coli. See *E. coli*
 Bacteroides, 90
 Bacteroidetes, 89
 Baltimore system, 77
 Baltimore, David, 77
 barophile, 137, 139
 Bateson, William, 173
- Beijerinck, Martinus W., 76, 134, 136, 161, 164, 173
 Benton, Michael, 63
 Benzer, Seymour, 178
 Bergey, David, 67
 Bergey's Manual, 67
 bilaterian development, 124
 binary fission, 51, 72
 biodiversity, 3–6, 36, 132
 estimates, 145
 excluding prokaryotes, 145
 functional diversity, 147
 quantification by DNA, 142
 units, 132, 144
 biofilms, 2, 45, 60, 120–1, 137, 157, 192
 multilineage biofilms, 111–12
 biogeochemistry, 3, 6–8, 22, 155, 161, 198
 biogeography
 community assembly, 165–9
 deterministic assembly, 167
 neutral/stochastic assembly, 167–8
 cosmopolitanism, 164
 endemism, 164
 immigration, 166
 island biogeography, 165–7
 microbial biogeography, 164–9
 neutral theory, 168–9
 species-area relationship, 162–8
 z-slope. See species-area relationship
 bioremediation, 205
 Blakemore, Richard, 26, 29–30
 Bolker, Jessica, 189–90
 bottleneck, 114, 158–60
 Botstein, David, 119, 121
 Bouchard, Frédéric, 40, 115, 158
 Brenner, Sydney, 178
 Brock, Thomas D., 66, 139–41, 145, 161, 173, 179, 207
Buchnera, 160
 butyric acid bacterium, 174

- Cairns, John, 98, 100–1
 Candolle, Alphonse Pyramus de, 162
 capsid, 77, 210
 carbon cycle, 6–7
 carbon fixing, 5–6, 17, 19, 21
Caulobacter crescentus, 121
 Cavendish, Margaret, 36
 cell
 cell adhesion, 183, 188
 cell counting, 141
 cell differentiation, 20, 120–2
 cell division, 174, 188
 cell membrane, 59
 cell movement. See chemotaxis, magnetotaxis, phototaxis, flagellum
 cell nucleus, 51, 60, 111, 121, 157, 194
 cell size, 45, 165
 cell type, 12, 19, 52, 58, 80, 117, 120–1, 210
 cell wall, 2, 58
 in fungi, 50
 cellular adhesion, 21
 cellular decision making, 191–2
 cellular organisation, 58
 cellularity, 51, 157, 210
 communication, 21, 108–9, 120, 123, 152, 172, 180, 188, 190–2
 evolution, 79–80
 germ cell, 95, 100, 158, 221
 hybrid cell, 19
 lysis, 7, 73, 139
 membrane, 54
 programmed cell death. See apoptosis
 virtual cell, 180
 cellulose digestion, 137
 de Chadarevian, Soraya, 16
Chaos infusoria, 66
 cheater, 108, 110, 191–2
 chemoautotrophy, 5, 133, 219
 chemoheterotrophy, 219
 chemolithotrophy, 133
 chemoorganotrophy, 5, 219
 chemostat, 184–6
 chemotaxis, 190–1, 221
 chitin, 50
 chlorophyll, 17–18
 bacteriochlorophyll, 18
 chloroplast, 10, 19, 23, 106, 219
 ciliates, 63, 185, 194
 classification, 2, 45–7, 197, 213
 asexual organisms, 72, 85
 boundaries, 42, 50, 82, 91
 cryptic diversity, 50, 86
 ecotype, 74–5, 145
 environmentally oriented classification, 86
 form species/genus, 66
 genus concept, 83
 hierarchy, 47, 64, 70–90, 157, 208, 212, 217
 natural vs. pragmatic, 92
 phylogeny, 74, 80–3, 91, 142, 168–9, 200
 and LGT, 102, 104
 phylotyping, 19, 88, 138, 145–6
 phylum concept, 88
 polyphasic species, 71, 75–6, 78, 86
 protists, 93
 species concept, 61, 64–6, 71–2, 82, 85
 biological species concept (BSC), 72, 84–5
 ecologically-defined microbial species, 145
 paraspecies, 85
 universal species concept, 43, 85, 91–4, 208
 viruses, 76–80, 93
 Cleland, Carol, 210, 215
 Clements, Frederic E., 147, 149
 climate change, 205
 Cockell, Charles S., 203, 205–7
 coenocytes, 157
 cognition, 198
 Cohn, Ferdinand, 66, 68–9, 175
 collaboration. See symbiosis
 colonization, 150, 162
 colony, 2, 60, 183
 Colwell, Rita, 203, 205
 commensalism, 9, 87
 community, 87, 91, 116, 142, 156
 association studies, 147
 manipulation, 172
 plasticity, 143, 196
 community phenotype, 149
 community structure, 88, 144
 compartmentalization, 2, 51
 competitive exclusion principle, 184–5
 conjugation. See under lateral gene transfer
 conservation (microbial), 202–8
 ethics, 206
 conservation policy, 144, 203, 207
 cooperation, 156, 188, 190
 vs. conflict, 107, 113–15, 124, 192
 Copeland, Herbert F., 60, 94
 Cowan, Sam T., 92
 Crenarchaeota, 56
 CRISPR-Cas system, 100, 221
 crossing experiments. See genetics
 cryptomycota, 50
 cultivation. See culturing
 culturing (microbial), 33, 67, 86, 90, 186
 Currie, Adrian, 184, 200
 cyanobacteria, 6–8, 17–20, 120, 159, 219
 proto-cyanobacteria, 18

- cystic fibrosis, 170
 cytoskeleton, 58, 103
- Dallinger, William H., 181
 Darden, Lindley, 214
 Darwin, Charles R., 39, 82, 96–7, 128, 158, 181, 208
 Davies, Julian, 171–2, 206
 Dawkins, Richard, 158–60
 deep ecology, 206
 Delbrück, Max, 98, 174–6, 195
 Delft School of Microbiology, 13, 135, 139, 142, 154, 174
 Demerec, Milislav, 174
 denitrification, 7
 development, 117–18
 development (microbial), 119–24, 188–9
 Diamond, Jared M., 187
Dictyostelium, 119, 122
 diderm, 59
 dinoflagellate, 107
 disease, 69–70, 87
 disease ecology, 170
 diversity-productivity relationship, 162
 Dixon, Bernard, 203
 DNA
 amplification. See polymerase chain reaction
 DNA repair, 99–100
 DNA-DNA hybridization, 75
 introgression. See lateral gene transfer
 intron, 51, 177
 negative- and positive sense strand, 77
 plasmids, 73, 104–5, 130
 repair, 54
 replication, 54
 reverse-transcription. See retroviruses
 selfish DNA, 105
 single- and double-stranded DNA/RNA, 77
 transcription, 54
 transduction. See under lateral gene transfer
 transformation. See under lateral gene transfer
 translation, 54
 Dobzhansky, Theodosius G., 9, 175
 domains, 47–59
 Doolittle, W. Ford, 52, 55–7, 82, 87, 105, 147–8
 dormancy, 4
 and sampling, 164
 Dretske, Fred, 27–8, 34–5, 193, 199
Drosophila, 174
 Dujardin, Félix, 66
 Dupré, John A., 9, 41–2, 46, 80, 117, 157, 180, 215
- E. coli* (*Escherichia coli*), 2, 86, 98, 174–8, 180, 182, 185
- citrate consumption, 182
 ecological equivalence, 166, 169
 ecology, 88, 90–1, 132–72, 198
 experimentation. See chemostat
 microbial vs. macrobial, 140, 168
 modelling, 160–9
 sampling vs. counting, 144
 tools and approaches, 140
 units of analysis, 143–60
 ecosystem, 148, 156, 198
 artificial, 185
 ecosystem plasticity, 143
 ecosymbiosis, 9, 111
 Ehrenberg, Christian G., 66, 132, 177
 elective culturing. See enrichment culturing
 electron transfer, 5, 18, 21–2, 31
 Embley, T. Martin, 10, 56
 endosymbiosis, 9, 19, 101, 106–7
 endosymbiotic gene transfer (EGT), 106
 enrichment culturing, 133, 135, 139, 161
 enterotype, 90
 environmental genomics. See metagenomics
 enzyme, 70, 134–5, 140, 151, 214
 eocyte, 56–7
 episybiosis, 9
 Eubacteria. See Bacteria
 Eukarya, 52–3
 eukaryogenesis, 55, 57
 eukaryote (definition), 2–3, 48
 eumetazoan, 124
Euprymna scolopes, 118
 Euryarchaeota, 56
 evo-devo, 117–24
 and modern synthesis, 118
 evolution
 adaptation, 22
 adaptive explanation, 28–35
 adaptive variation, 125
 co-adaptation, 41
 co-adaptive, 104, 113
 unit of adaptation, 112, 115–16, 127, 149, 212
 adaptationism, 29, 32–3, 165
 pan-adaptationism, 32
 anti-adaptationism, 32
 and ecology, 135
 anti-Darwinism, 155
 artificial evolution, 37
 bet-hedging, 123
 co-evolution, 88
 Darwinism, 12, 96, 99, 116, 181–2
 neo-Darwinism, 131, 158
 directed evolution, 100
 directed mutation, 99

- evolution (cont.)
 drift, 104
 evolutionary group, 47
 evolutionary transitions, 17–25, 182, 211
 hierarchy, 20
 evolvability, 18, 24, 43, 105, 124–8, 181–2
 and asexuality, 125
 exaptation, 32, 105, 220
 experimental evolution, 124, 128, 182–4
 fitness, 183
 group fitness, 114, 130
 genetic drift, 74
 Lamarckian processes, 96, 98–101, 116, 175, 221
 micro- vs. macroevolution, 182
 modern synthesis, 40, 72, 84–5
 and microbes, 61
 natural design, 29
 neutral evolution, 84
 neutral theory, 182
 non-adaptive, 31, 84, 96, 104, 126
 of antibiotic resistance, 171
 of collaboration, 110
 of communication, 191–2
 of cooperation, 108–17, 124
 of metabolism, 24
 of multicellularity, 127, 182
 of photosynthesis, 17–23
 of sociality, 24
 of the cell, 79–80
 origins of life, 209
 spontaneous generation, 66, 69, 96,
 181, 208
 philosophy of, 40
 preadaptation. *See* exaptation
 selection
 clade selection, 127
 community-level selection, 153, 156
 for evolvability, 126
 for sex, 105
 group selection, 122–4
 kin selection, 110, 129, 192
 multilevel selection, 108, 110, 113, 185
 natural selection, 20, 26, 32–3, 39,
 46, 208
 purifying selection, 104
 second-order selection, 99
 selection pressure, 171
 unit of selection, 12, 20–1, 113, 116, 130,
 159, 213
 social evolution, 191
 speciation, 22, 42, 61, 83–4, 88, 220
 allopatric speciation, 84, 220
 and asexuality, 97
 hybrid speciation, 129
 sympatric speciation, 84, 220
- exobiology, 210
 extinction, 21, 208
 extremophile, 5, 17
- facultative sex, 61
 Falkowski, Paul G., 6, 8, 17–19, 21–2
 Ferguson Wood, Edward J., 138
 fermentation, 69
 filament, 21, 45, 120, 157, 183
 Firmicutes, 89–90
 flagellum, 3, 25, 54
 Fodor, Jerry A., 26, 34
 food web, 139, 185
 Forster, Johann R., 162
 Forterre, Patrick, 55, 79, 210
 Fracastoro, Girolamo, 68
 Frankel, Richard B., 25–6, 29–30
 fruiting body, 121
 function
 exaptation, 32
 functional classification, 111, 115, 167
 functional diversity, 147, 149, 153
 functional redundancy, 153–4, 204
 in communities, 153–4
 in philosophy, 147
 transfer of. *See* lateral gene transfer
 fungi, 2, 19, 48, 120, 129, 175, 183
- Gaia theory, 106, 136, 206
 Gause, Georgy F., 184, 186–7
 gene
 barcode, 74
 community function, 143
 gene duplication, 81
 gene regulation
 operon, 98
 regulatory network, 124
 gene replication, 175
 gene sequence, 80
 hitchhiking gene, 99
 hypermutation, 99, 126
 informational gene, 102
 jumping gene. *See* transposable element
 mutator gene, 96
 one-gene-one-enzyme, 135
 operational gene, 102. *See* housekeeping
 selfish gene, 130
 genetics (microbial), 14, 173–9
 and unity of life, 174, 186
 genetic programme, 119–20
 mutations and inheritance, 98
 genome
 community genome, 148
 core genome, 81
 genome duplication, 45

- genome reduction, 102
 genome sequence, 142
 genomic diversity, 91
 genomic island, 25
 genomics, 180
 hologenome theory, 116
 mosaic genome, 106
 pangenome, 81
 sequencing, 179
 species genome, 81
 virus genome, 77
 whole-genome analysis, 179
 whole-genome sequence, 122
 genotype-phenotype map, 180
 geobiology, 136
 geochemistry, 3, 23–4, 143
 geoengineering, 205
 germ theory, 68
 germ-free mice, 150
 Gleason, Henry A., 148
 Godfrey-Smith, Peter, 28, 33, 37, 116, 159–60
 Goldenfeld, Nigel, 100
 Gould, Stephen J., 8, 32, 34–5, 211–12
 Gram stain, 2, 58–9, 70
 great plate count anomaly, 141
 greigite, 25
 guild, 111
 Gupta, Radhey S., 59
 gut, 89–90, 149–51, 171, 198
 influence on brain, 151

 Hacking, Ian, 36, 39
 Hadley, Philip, 71, 120
 Haeckel, Ernst, 60, 69, 135
 Hagen, Joel B., 48
 haloarchaea, 104
 halophile, 5, 104, 136, 139
 Hamilton, William D., 110
 Hayes, William, 176–7
 d'Hérelle, Félix, 77
 heterocyst, 120
 heterotrophy, 5
 Hill, John, 66
 history
 of microbial ecology, 132–43
 of microscopy, 35–40, 65–6, 69–70, 119, 175, 208
 Hooke, Robert, 36
 Hubbell, Stephen P., 166
 human exceptionalism, 201
 humanized mice, 150
 Hungate, Robert E., 137, 141, 161
 Huxley, Julian, 40, 96–7
 hybridization, 72

 hydrogenosome, 10
 hydrothermal vent, 21, 107, 138–9, 144
 hypermutation, 182, 221

 immersion slide, 139
 individuality, 40, 111, 115, 156–60
 nested individuals, 116, 157
 information-based inheritance, 127
 infusoria, 60, 66, 177
 Ivanovskii, Dmitry, 77

 Jacob, François, 174
 Jannasch, Holger W., 137–40, 161, 186
 just-so stories, 32

 Kant, Immanuel, 208
 kingdoms, 47–51
 Kipling, Rudyard, 32
 Kluyver, Albert J., 135, 154, 174
 Koch, Robert, 69–70, 170
 Koch's postulates, 70, 170
 Koonin, Eugene V., 54, 79, 93, 96, 100, 104, 130, 210
 kwashiorkor, 151

 Lamarckism. See under evolution
 lateral gene transfer (LGT), 18, 25, 72, 80–5, 91, 100–8
 competence, 73, 105, 123
 conjugation, 73, 176–7
 costs, 104
 EGT. See endosymbiotic gene transfer
 gene cassette, 104
 homologous recombination, 51, 72–5, 82, 104, 177
 in animals and plants, 129
 integron, 104
 mobile genetic agent, 73
 mobile genetic element, 12, 159
 placenta, 129
 progenote theory, 105
 protection from, 221
 rates, 101
 transduction, 73, 177
 transformation, 21, 73, 176
 transposable element, 103
 law (biology), 162
 Lederberg, Joshua, 98, 174, 176–7
 Leeuwenhoek, Antonie van, 35, 65, 175
 legume, 112
 Leibniz, Gottfried W., 116, 157
 Lenski, Richard E., 99–100, 126, 182
 Levin, Bruce R., 95, 123, 182, 184, 197
 Levy, Arnon, 183, 200
 Lewontin, Richard C., 32

- lichen, 19, 159
 life, 44, 46, 77
 continuity, 201
 definition, 208–13
 Linnaeus, Carl, 47, 66, 68, 70
 lipid profile, 75
 lipids, 54
 López-García, Purificación, 55, 77, 79
 Love, Alan C., 124, 188–9, 191–2, 199–200,
 212, 215
 Luria, Salvador E., 98, 175
 Lwoff, André, 79
 Lynch, Michael, 96, 126, 128
- MacArthur, Robert H., 166–7
 macrobe (definition), 2. See macroorganism
 magnetite, 25, 31
 magnetosome, 25, 58
 magnetotactic bacteria, 16, 25–41, 193
 magnetotaxis, 25–41
 manipulation (experimental), 97
 Margulis, Lynn, 48, 61
 marine microbiology, 7, 133–7, 141, 185
 Maurer, Russell, 119, 121
 Maynard Smith, John, 20, 23–4, 72, 211–13
 Mayr, Ernst, 42, 53, 57, 61, 72, 76, 83–5, 97
 McShea, Daniel W., 20
 medical microbiology, 133–70, 174
 meiosis, 51, 72
 membrane, 3
 memory, 190–1, 221
 Mendel, Gregor J., 134
 mental content, 28
 metabolism
 and unity of life, 174
 evolutionary transition, 24
 metabolic activity, 22, 107, 134, 137
 metabolic diversity, 21
 metabolic mutualism, 5
 metabolic network, 18
 metabolic partnerships, 157
 metabolic pathway, 6, 19, 22, 52, 74
 metabolic productivity, 19
 metabolic versatility, 5
 metabolite sharing, 21
 prediction from rRNA, 145
 thermodynamic possibility, 6
 metagenomics, 70–86, 142–3, 148, 165,
 168–70
 metaorganism. See superorganism
 metazoan, 63, 120, 183, 195, 198
 microaerophile, 25
 microbe (definition), 2
 microbes as model organisms, 98
 microbial extinction, 38
 microbial sex, 177
 microbiome, 87–90, 149–53, 170
 core microbiome, 88–9, 153
 microbiota, 89, 149, 151–2, 170, 199
 microfungus, 110
 microorganism. See microbe
 microscopist, 35, 39, 66, 181
 Millikan, Ruth G., 27–9, 34–5, 193, 199
 mimiviruses, 55
 mitochondrion, 10, 19–20, 23, 106, 113
 mitosis, 51, 72
 mitosome, 10
 mixotrophy, 5, 219
 model, 184, 217
 mathematical model, 154, 161–2, 179, 184, 186
 minimal model, 33–4
 model system, 34, 128, 131, 173, 186, 193
 microbe vs. macrobe, 194, 197–8
 representativeness, 173, 179, 189–92
 tractability, 123, 172, 179, 183, 189–96
 vs. model organisms, 190
 modern synthesis
 and evo-devo, 117
 and microbes, 95–8, 131
 modularity (genome), 122
 monad, 128, 181
 Monera, 48, 53, 60, 69
 Monod, Jacques L., 174, 184
 monoderm, 59
 monophyletic, 48, 220
 Moreira, David, 55, 77, 79
 morphogenesis, 119
 Müller, Otto F., 66
 multicellularity, 20–1, 24, 37, 41, 119, 156
 evolution of, 182
 multilineage group, 87, 110–12, 115, 120, 128,
 131, 157–60
 mutation
 mutagenesis, 98
 reversion, 98
 mutator strain, 99
 mutualism, 9, 110–11, 123, 191
 in viruses, 112
 mycelium, 110
Mycoplasma genitalium, 180
 mycorrhizal fungi, 111
Mycrococcus, 119
- natural kind, 47, 55, 60, 76, 92
 natural selection. See under evolution
 neomycin, 136
Neurospora, 175
 niche, 6, 21, 25, 78, 89, 168, 185, 193
 niche concept, 162
 nitrification, 7

- nitrogen cycle, 6
 nitrogen fixing, 7, 118, 120
 Novick, Aaron, 184
 nucleoid, 58
 nutrient flow, 161
- obesity, 88–9, 170–1
 obligate dependency, 9
 obligate mutualism, 114
 Odum, Eugene P., 154
 oomycetes, 50
 operational taxonomic unit (OTU)
 (definition), 146
 Opisthokonta, 197
 organelle, 10, 19, 25, 31, 219
 organism concept, 41, 46, 113, 156, 158
 collaborative reproduction, 159
 organismal bias, 97
 See also zoocentrism.
 osmotrophy, 50
 oxygen, 18–20
 cycle, 6
 Great Oxidation Event, 6, 21, 198
 oxygenation. See Great Oxidation Event
 tolerance, 21
- Pace, Norman R., 52, 54, 141, 161
Paenibacillus vortex, 108, 110
 panda, 151, 205, 207
 paramecium, 26, 34, 184
 paraphyletic, 48, 220
 parasexual, 72
 parasitism, 107, 111
 parasitoid wasp, 112
 Pasteur, Louis, 69
 pathogen, 90, 123, 136, 150, 170, 176,
 198, 203
 penicillin, 171
 perception, 35–6
 peroxisome, 31
 persistence (ecological), 4, 111, 123, 153, 171
 persistence (evolutionary), 9–10, 37, 41, 88,
 104–6, 125, 130, 158–60, 212
 of function, 115, 204, 213
 phage, 2, 76–80, 177
 genetics, 175
 life cycle, 121
 mutation rates, 78
 pathogenicity, 77, 206
 protection from, 100, 221
 recombination, 176
 sequencing, 179
 symbiosis, 112
 phagotrophy, 50
 phase variation, 71
- phenotype switching, 123
 phenotypic plasticity, 68, 123, 193
 phylogeny. See under classification
 unrooted tree, 62
 philosophy of biology, 41–2, 174–96, 214
 photic zone, 18
 photoautotrophy, 5
 photoheterotrophy, 5
 photosynthesis, 10, 17–23, 107, 120, 139, 219
 anoxygenic photosynthesis, 18
 loss of, 10, 219
 oxygenic and anoxygenic, 135
 photosystem, 5, 18
 evolution, 18
 photosystem. See under photosynthesis
 phototaxis, 30, 37
 phototrophy, 5, 17, 104
Physarum polycephalum, 121, 191
 phytoplankton, 19, 138
 plasmodium, 121
 plastids, 19–21, 106, 113, 157, 219
 pleomorphy, 68
 pluralism, 93, 214–15
 pneumococcus, 176
 polymerase chain reaction (PCR), 139, 142, 179
 polymorphism, 68
 polyphyletic, 25, 54, 220
 polythetic, 78. See polytypic
 predator-prey dynamics, 184–5, 193
 Prevotella, 90
 Primalia, 60
 primary production. See autotrophy
 prions, 157
 progenote theory. See under lateral gene transfer
 prokaryote (definition), 2
 protist, 2, 5, 17, 36, 48, 60–3, 69, 71, 121,
 165, 191
 protoeukaryote, 20, 23
 Protozoa, 60
 pseudofungi, 50
 psychrophile, 5
 pure culture, 69–70, 87, 132, 138, 140
- Queller, David C., 113
 quorum sensing, 192
- Raoult, Didier, 46, 55, 210
 Ratcliff, Marc J., 37, 65
 Ratcliff, William C., 183
 Redfield, Rosemary, 105
 redox, 5, 7, 18, 29, 31, 107, 120
 reductionism, 99, 118, 196
 reduction-oxidation. See redox
 Relman, David A., 88–9, 151, 153, 170–1
 replicator, 20, 24

- representation, 26–37, 39, 188
 reproduction, 159
 collaborative reproduction, 159
 reproductive isolation, 61
 respiration, 5–6, 18, 31
 Rhizobium, 7, 110–12, 118, 186
 ribocell, 210
 ribovirocell, 210
 ribosomal RNA. See rRNA
 ribosome, 74
 Richards, Thomas A., 46, 51, 102, 105, 147
 Richmond, Mark, 97
Riftia pachyptila, 107
 rights (conservation ethics), 206
 RNA viruses. See retroviruses
 rotifer, 103
 Royal Society, 39
 Royal Society of London, 35
Rozella, 50
 rRNA, 74, 88, 141, 165
 rumen, 137, 141
Ruminococcus, 90

Saccharomyces cerevisiae, 120
Salinibacter rubrum, 104
 sample-based inheritance, 127
 sampling, 79, 86, 161
 diversity estimation, 146, 164
 environmental sampling, 50, 132, 143–5
 great plate count anomaly, 141
 low-abundance organisms, 164
 marine sampling, 137
 viral diversity, 77
 Samuelson, James, 181
 Schaechter, Moselio (Elio), 77, 91, 169
 Schatz, Albert, 136
 Schrödinger, Erwin, 209
 sea urchin, 122
 secondary endosymbiont, 107
 selection. See under evolution
 selfishness, 105, 108, 111–12, 209
 selfish metabolism, 130
 self-replication, 77
 sexuality (bacteria), 175
 sexual metaphors, 177
 Simpson, Carl, 20
 Slater, Matthew H., 92–3
 smallpox, 203
 social behaviour, 109
 social evolution, 23, 109, 129, 191–2
 social IQ, 108
 soil, 4, 120, 133, 136, 154
 Sonneborn, Tracy M., 194
 spandrel, 32
 speciation. See under evolution

 species. See under classification
 specificity, 68–9
 spore, 119, 121, 192
 Staley, James T., 141, 203, 207
 Stanier, Roger Y., 51, 79, 133, 145, 154
 Steele, Edward J., 100
 Sterelny, Kim, 20, 23, 122, 127, 148, 211–12
 Strassmann, Joan E., 113
Streptococcus pneumoniae, 176
 Streptomyces, 120
 streptomycin, 136
 succession theory, 162
 sulphur oxidation, 107, 120, 127
 superkingdom, 52
 superorganism, 105–6, 147–8, 155–6.
 See metaorganism
 symbiosis, 9–10, 22, 88, 127, 139, 156–7
 syncytia, 157
 syngamy, 51
 synthetic biology, 180
Systema Naturae, 66
 systems biology, 180
 Szathmáry, Eörs, 20, 23–4, 117, 211–13
 Szilárd, Leó, 184
 Szostak, Jack W., 210

 Tabery, James, 214
 Tansley, Arthur G., 148, 154
 Tatum, Edward L., 98, 175–6
 taxa-area relationship. See under biogeography
 taxonomy. See classification
 teleosemantics, 25–31, 33–4, 194, 216
 thermodynamic prediction, 141
 thermophile, 5, 107, 139, 207
Thermus aquaticus, 139, 179
Thiomargarita, 45, 120
 Tiedje, Jim M., 140–1
 tobacco mosaic virus, 134
 transduction. See under lateral gene transfer
 transformation. See under lateral gene transfer
 transposable element. See under lateral gene transfer
 Travisano, Michael, 124, 182–3, 188–9, 191–2,
 199–200
 tree of life, 79, 82, 93, 141
 tubeworm. See *Riftia pachyptila*
 tubulin, 103
 Turner, Derek, 216–17
 Twort, Frederick W., 77

 unicellularity, 2, 46, 128, 157
 uniformity. See specificity
 unit of conservation, 205
 unit of ecology, 44
 unit of selection, 20

- unity of life, 174, 186–96
 urkingdom, 52
- vaccination, 203
 vagus nerve, 198
 value (intrinsic vs. instrumental), 205
 van Niel, Cornelis B., 51, 79, 135, 137, 140,
 142, 154, 157, 169, 172, 190
 vertical inheritance, 22
Vibrio, 118
 virocell, 55
 virome, 150
 virtual life, 180, 187
 viruses, 2
 classification, 76–80
 concept of virus, 79
 contagium vivum fluidum, 77
 large viruses, 210
 origins of life, 209
 provirus, 221
 quasispecies, 78
 reproduction, 2, 174
 retroviruses, 100, 103, 129, 221
 See also phage.
- vitalism, 201
 Volvox, 122, 127
- Waksman, Selman A., 136, 172
 whale, 205, 207
 whitefly, 107
 Whitman, William B. (Barney), 4, 7, 55
 Whittaker, Robert H., 48, 51, 57, 60, 80
 Wilson, Edward O., 144, 166–7
 Winogradsky, Sergei, 133–4, 136, 145, 161
 Woese, Carl R., 48, 52, 54, 56, 74, 82, 100, 105, 115
Wolbachia, 103, 107, 118, 127
 Wolf, Yuri I., 96, 100
- yeast, 2, 120, 183–4
 Yellowstone, 139, 207
- Zhaxybayeva, Olga, 52, 55–7, 87, 105, 147–8
 Zinder, Norton D., 177
 ZoBell, Claude E., 137, 139, 141, 161
 zoocentrism, 41–2, 119
 See also organismal bias.
 zooxanthellae, 107
 z-slope. See under biogeography