

Index

A

Abstract thinking, 105
Abstraction, levels, 106
Accommodation, 78
Accumulators, Li^+ 227
 Pb/PbO_2 227, 240
Acetic acid, 254, 265
Acid deposition, 230
Acids, 196
Air, composition, 31
 density, 13, 28
Air pressure, Guericke, 7
Albertus Magnus, 4
Alchemy, 3
Alcohol test, chromate type, 229, 241, 255
Alcoholic beverages, 253
Alcohols, 251, 264
Alkaline metals, dissolution in water, 25
 pieces, 139
 salts, flame colors, 142
 water, 140
Alkaline-earth metals, water, 132, 149
Alloys, 304
Aluminum chloride hexahydrate, 224
Amalgams, 304
Ammonium carbonate, 225
Anions, 307
Arrhenius, acids, 196
 ions, 297
Ascorbic acid, 269
Assimilation, 78
Atomic absorption spectroscopy (AAS), 124
Atomic mass unit, 192
Atomic model, quantum mechanical, 158
Atomic orbital model (Schroedinger), 170, 206
Atomism, 7

Atoms, 318
 basic particles of matter, 296
Attitudes, 43, 79
 changes, 219
Audio-visual media, 231
Avogadro's law/constant, 192, 316

B

Baking soda, 225
Ball-and-stick model, 160
Bases, 196
Benzene, Kekulé, 122
Black carbon, sugar, 56
Blackboard, 97
Bleach, 226
Blue lightning, 54
Bohr, 170
Bonding, 169, 297
 models, 159
Bonding number, 195
Boyle, 120
Bragg equation, 124
Brass name plate, 57
Bromine test, 281
Bromothymol blue test, 250, 279
Brønsted, acid, 196
Butane, 13, 139
 condensation, 32
 evaporation, 16

C

Calcium phosphate, 229
Candle, burning, 27
Canonicus, 5

- Car battery, 105, 116
 - Car exhaust, 230
 - Carbon, combustion, 28
 - from carbon dioxide, 32
 - Carbon–oxygen reaction, 167
 - Carbon dioxide, density, 28
 - solubility, 47
 - Carboxylic acids, 250
 - Catalytic convertor, 230
 - Cations, 307
 - Cerium nitrate test, 250, 255, 278
 - Cesium, 165
 - Cs–137, 165
 - Charge number, 195
 - ChemCom, 233
 - Chemical bonding, models, 159
 - Chemical energy, 10
 - Chemical reaction, 195
 - models, 159
 - Chemical structure, models, 159
 - Chemical symbols/formulas, 81, 104, 202
 - Chemical synthesis, 124, 250
 - Chlorine, reaction with sodium, 141
 - Christmas Lectures, 48
 - Chromatography, 124, 138
 - Citric acid, 269
 - Closed apparatus, 12
 - Coal, burning, energy, 38
 - Cognitive conflict, 46
 - Cognitive development, 78
 - Cognitive skills, 247
 - Cola, densities, 48, 55
 - Combustion, 47, 148, 210
 - processes, 10
 - Competency model, 69
 - Compounds, 120
 - Comprehensible lessons, 44
 - Computers, use in class, 100
 - Concept cartoons, 18, 34, 108
 - Concept maps, 199
 - Conceptual growth/change, 78
 - Concrete operational stage, 78
 - Conservation of mass, 9, 109
 - Conservation of matter, 28
 - Conversion factors, 191
 - Coordination polyhedrons
 - Copper, color change, 43, 50
 - Copper oxide, 9, 24, 148
 - Copper sulfate, 281
 - iron mail, 37
 - Crystal structure, models, 158, 160
 - Cs–137, 165
 - Curiosity, 135, 218
 - Curricula, Germany, 67
 - UK, 75
 - USA, 71
- D**
- 3D-drawing model, 160
 - Dalton, 121, 155, 203, 295
 - Data collection, 124
 - Democritus, 7
 - Demonstration experiments, 133
 - Density, 191
 - Deodorants, 224, 239
 - Developer, 226, 240
 - Development, cognitive, 78
 - stages, 42
 - Developmental psychology, 78
 - Diamond, 170
 - Dichromate test, 283
 - Didactical approaches, 85
 - Didactical models, 63
 - Didactical reduction, 104
 - Dilution series, 130, 146
 - pH, 146
 - Dinitrophenylhydrazine (DNPH) test, 280
 - Discontinuity, 7
 - Discrepancies, 17
 - Display models, 159
 - Disposal, 126
 - Distillates, 251
 - Dithionite, 226
 - DNA model, 174
 - Donor–acceptor reactions, 199
 - Drain cleaners, 131, 149
 - Drinking water, disinfection/chlorination, 230
 - Driver, 10
 - Dye remover, 226
 - Dynamic models, 162
- E**
- Educational goals, 78
 - Educational system, Germany, 69
 - Electricity from lemon, 56
 - Electrons, 206
 - Elements, 119
 - Emotions, 47
 - Empedocles, 5
 - Energy, 10, 195
 - Enthalpy, 195
 - Environmental protection, 136
 - Equation, 193
 - Equilibration, 78

- Equilibrium, simulation, 173
Equipment, handling, 136
Ester hydrolysis, 284
Esterification, 284
Esters, 251
 sodium hydroxide, 255
Etching, Fe^{3+} , 227
Ethanoic ethyl ester, 255
Ethanol, evaporation/condensation, 32
Ethylene, 269
Evaluation, 271
Everyday life, 45, 136, 217
Everyday phenomena, 222
Experimental kits, 111
Experimental skills, 49, 124, 135
Experiments, 101, 119
 purpose, 128
 selection criteria, 128
Explosions, gas mixtures, 54
Extinguishing fires, 47, 54
- F**
Fehling test, 280
Fertilizer, 229
Fire air, 5
Fire extinguisher, 241
Fixer, 226
Flame colors, 142
Flashing cement, 241
Foam extinguisher, 241
Formal operational stage, 78
Formulas, 62, 193, 202, 214
Free enthalpy, 195
- G**
Galilee, 5
Gas chromatography (GC), 124, 138
Gases, properties, 29
Generalization of facts, 171
Genetic learning, 45
Glass-tube-cylinder model, 171
Glycolic acid, 262
Gold, artificial, 4
Gold amalgam, 304
Gooseneck camera, 102, 115, 134
Graphite, 170
Group dynamics, 136
Guericke, 6
Guidelines, Germany, 67
 UK, 75
 USA, 71
- H**
Haber process, 229
Half-life, 163
Halogenated hydrocarbons, 128
Hands-on, 48
Hazard symbols, 127
Hazardous substances, 126
Headline goals, 62
Health, 224
Heat substance, 5
Hexadecane, 138
Hexamethylene diamine, 172
Historical experiments, 130, 137
History-problem-oriented approach, 87
Homologous series, 262
Horror vacui, 3, 5, 7, 16, 122
Household chemicals, 221
 analysis, 252
Human element, 22
Hydrocarbons, disposal, 128
 separation, 138
Hydrochloric acid, composition, 37
Hydrogen experiments, 30
Hydrogen sulfide, 178
Hydrogen–oxygen reaction, 314
Hydroquinone, 226
Hydroxide ions, 196
Hygiene, 223
Hypotheses, 172
 proof, 122
- I**
Ice, melting temperature, 46
Ice–water mixture, 43
Infrared spectroscopy, 313
Infrared spectroscopy (IR), 124
Interdisciplinarity, 88
Interest, 42, 79, 218
Intrinsic motivation, 44
Iodized salt, 225
Iodoform test (Lieben test), 251, 282
Ionic charge, 307
Ionic structures, 309
Ions, 195, 203, 210, 318
 basic particles of matter, 296
 combination, 307
 Dalton's atomic model, 295
 size ratios, 307
Iron chloride test, 282
Iron hydroxide, precipitation, 205
Iron sulfide, 293
Iron wool, 2, 10, 27

Isomerism, 197

IUPAC, 190

J

Johnstone's triangle, 209, 294

Joule (J), 191

K

Kekulé, 122, 155, 194

Klafki model, 64

Kolbe electrolysis, 269

L

Lab classes, organization, 134

Laue, three-dimensional crystal structures, 155

Lavoisier, 5, 120

Learning doctor, 18

Lecture planning, 65

Length unit (meter), 190

Lesson planning/analysis, 64

Lesson plans (suggestion), 89

Leucippus, 7

Liebig, 48, 119, 248

 combustion analysis, 130, 148

Limestone, acid rain, 228

Liquefied gas, 13

Lithium–water reaction, 132, 141, 150

Lithium chloride-melt, electrolysis, 142

M

Magnesium, 210

 combustion, 12

 shavings, 149

Manual skills, 136

Mass media, 111

Mass spectrometry (MS), 124, 258

Mass unit, 191

Mass-charge model (Dalton), 170

Mathematical logical facts, illustration, 171

Matter, structure, 20

Media, 93

 appropriateness, 103

 classification, 94, 97

 effects, 95

 function, 96

Media sets, 111

Melting temperature, 51

Mental models, 153

 interdisciplinary, 177

Mercury, 24

 electrode, 130, 147

 waste, 128

Mercury oxide, 5

Metal lime, 4

Metals, atoms, 297

 burning, 26

 crystal structures

 reactivity, 141

 structural models, 178

Methods, teaching goals, 81

Methyl lithium, polymeric, 292

Mineral tablets, 224, 239

 gas volumes, 53

Misconceptions, 18, 34

Models, 153

 use in class, 103

Molar mass, 192

Molar volume, 192

Mole unit, 192

Molecular models, 168

Molecular structures, models, 160

Mortar, hardening, 228

Motivation, 44

Multimedia, 101, 231

N

Nail polish remover, 254

National Curriculum (NC), U.K. 75

National Science Education Standards (NSES),
U.S. 71

Natural substance analysis, 262

Neutralization, 196, 209

Newspaper reports, 98

Nitinol, 303

Nitric oxide–carbon disulfide, 48, 54

Nitrogen analysis, 238

Nitrogen oxides, 230

NMR spectra, 258

Nonmetal atoms, bonding valences, 313

 combination, 312

Nonmetals, reactions, 314

Nuclear magnetic resonance spectroscopy
(NMR), 124

Nucleus and shell model (Rutherford),
170, 206

Nucleus and subshell model (Bohr), 170

Nylon, 172

O

Objective criticism, 219

Observation, 136

Open apparatus, 12
Operationalized goals, 62
Orbitals, 206
Overhead projector, 101, 113, 134
Oxidation, 285

P

Packing-of-spheres model, 160, 167
Parameters, 190
Particle-level models, 162, 256
Particle model of matter, 166
Particles, 193
Pascal, 6
Pedagogical Content Knowledge (PCK), 21
Pedagogy-Content-Context-Research
Knowledge (PCCRK), 21
Personal hygiene, 224
Petri dish, projected, 114
pH-values, 130
Phenolphthalein test, 250, 279
Phenomena-oriented and Inquiry-based
Network-Concept (PIN-Concept),
245
Phlogiston theory, 3, 4
Phosphorus, 11
Phosphorus–oxygen reaction, 316
Photography, 226
Photos, 100
Physical science, 74
Piatet, 8, 42, 78
Planning lessons/lectures, 65
Play instinct, 135
Potash apparatus, 130
Precipitation reactions, ions, 311
Preconceptions, 78, 79
Preoperational stage, 78
Primary education, Germany, 70
Prior knowledge, 108
Project-oriented approach, 87
Projection of electrolysis experiments, 114
Propanoic propyl ester, 256
Protocols, 136

Q

Quantum mechanical atomic model, 158
Quantum number, 206

R

Radioactive decay, 163
Radioactivity, 163

Reactions, illustration, 171
interpretation, 292
Real objects/processes, 104
Reduction, complex contexts, 171
Roentgen, X-rays, 123
Rojahn test, 250, 279
Rutherford, 170

S

Safety, 126
Salt, composition, 57
formation, 20
Salt crystals, sphere-packing model, 57
structural models, 180
Salts, lowering the melting temperature, 143
reactions, 311
Sanitary cleaner, 224, 239
Schroedinger, 170
Science as inquiry, 74
Scientific terminology, 189
Sensorimotor stage, 78
Shape memory, 303
SI units, 191
Slide projectors, 102
Slides, 100
Smog, 230
Social methods, 85, 86
Sodium, reaction with chlorine, 141
Sodium amalgam, 303
Sodium bicarbonate, 225
Sodium chloride, freezing point
depression, 295
ion lattice, 308
particles, 36
Sodium dithionite, 226
Sodium hydroxide, 129, 144, 148
reaction with air, 144
reaction with carbon dioxide, 145
solution, concentration/pH, 146
electrolysis, 144
Soil acidification, 230
Solid waste, 128
Solubility, 201
Solution process, particle concept, 14
Sound movies, 100
Space, particles in gas, 15
Space test, 107
Space-filling model (calotte model), 160
Spatial conception/ability, 106
Spectral analysis, 257
Spheres, packing, 300
Spiral curriculum, 73, 82, 200

Spot remover, 254
 Steinbuch, 155, 201
 Stereoisomers, 197
 Stick model, 160
 Stoichiometry, 211
 Striking experimental effects, 47
 Structural models, 81, 153
 perception, 106
 Structure of matter, 14
 Structure-oriented approach, 291
 Structure-properties relation, 260
 Student preconceptions, 43
 Students' conceptions, 17
 Substance identification, 248
 Sugar, dissolving crystals, 167
 sulfuric acid, 56
 Symbols, 189
 Syntheses, 124, 250, 284

T

Tab cleaner, 223, 239
 Table salt, iodized, 225, 239
 Tautomerism, 197
 Teaching, aims/goals, 61, 62
 methods, 85, 236
 problems, 83
 processes, 17, 44
 Television, 100
 cameras, 102
 Temperature units, 193
 Terminology, 189
 Terms, 190
 Tetrahedral-ZPD metaphor, 21
 Textbooks, 97, 232
 Textile dye remover, 226
 Thermal energy unit (calorie), 191
 Thinking in models, 155
 Time unit (second), 191
 Toilet cleaner, 224, 239
 Tooth fillings, amalgam, 304

Torricelli (Torr), 6, 7, 122
 Toxic substances, 126
 Toys, 176
 Transformation concept, 3
 Transparencies, 98

U

Unit cells, model, 158, 160
 symbols for ionic structures, 310
 Units, 190

V

Vacuum, Torricelli, 23
 Valence, 194
 Valence shell electron pair repulsion model
 (VSEPR, Gillespie), 170
 Validity, 103
 Video camera, 134
 Videos, 100
 Vinegar, 253

W

Wagenschein, 45
 Water, 34
 boiling temperature, 47, 52
 formation, 20
 Watson and Crick, 174
 Wave mechanics, 206

X

X-ray structure analysis, 124, 139
 X-rays, 123

Z

Zone of Proximal Development
 (ZPD), 21