

# Contents

<b>Introduction</b> . . . . .	1
<b>1 Perceptions of Ancient Scientists</b> . . . . .	9
1.1 The Theory of Basic Matter . . . . .	10
1.2 Transformation Concepts of the Alchemists . . . . .	10
1.3 The Phlogiston Theory . . . . .	11
1.4 Historic Acid–Base Theories . . . . .	12
1.5 “Horror Vacui” and the Particle Concept . . . . .	14
1.6 Atoms and the Structure of Matter . . . . .	15
References . . . . .	20
<b>2 Students’ Misconceptions and How to Overcome Them</b> . . . . .	21
2.1 Students’ Preconcepts . . . . .	21
2.2 School-Made Misconceptions . . . . .	24
2.3 Students’ Concepts and Scientific Language . . . . .	26
2.4 Effective Strategies for Teaching and Learning . . . . .	28
References . . . . .	33
Further Reading . . . . .	34
<b>3 Substances and Properties</b> . . . . .	37
3.1 Animistic Modes of Speech . . . . .	38
3.2 Concepts of Transformation . . . . .	39
3.3 Concepts of Miscibility for Compounds . . . . .	41
3.4 Concepts of Destruction . . . . .	43
3.5 Concepts of Combustion . . . . .	46
3.6 Concepts of “Gases as not Substances” . . . . .	50
3.7 Experiments on Substances and Their Properties . . . . .	52
References . . . . .	64
Further Reading . . . . .	65
<b>4 Particle Concept of Matter</b> . . . . .	67
4.1 Smallest Particles of Matter and Mental Models . . . . .	69
4.2 Preformed and Non-preformed Particles . . . . .	73

4.3	Smallest Particles as Portions of Matter . . . . .	76
4.4	Particles and the “Horror Vacui” . . . . .	78
4.5	Particles – Generic Term for Atoms, Ions and Molecules . . . . .	82
4.6	Formation of Particles and Spatial Ability . . . . .	83
4.7	Diagnosis Test for Understanding the Particle Model of Matter . . . . .	86
4.8	Experiments on Particle Model of Matter . . . . .	93
	References . . . . .	99
	Further Reading . . . . .	100
<b>5</b>	<b>Structure–Property Relationships . . . . .</b>	<b>103</b>
5.1	Structure and Properties of Metals and Alloys . . . . .	103
5.2	Existence of Ions and Structure of Salts. . . . .	108
5.3	Mental Models on Ionic Bonding . . . . .	115
5.4	Chemical Structures and Symbolic Language . . . . .	125
5.5	Experiments on Structure–Property Relationships . . . . .	130
	References . . . . .	140
	Further Reading . . . . .	142
<b>6</b>	<b>Chemical Equilibrium. . . . .</b>	<b>145</b>
6.1	Overview of the Most Common Misconceptions. . . . .	145
6.2	Empirical Research. . . . .	146
6.3	Teaching and Learning Suggestions. . . . .	156
6.4	Experiments on Chemical Equilibrium . . . . .	165
	References . . . . .	169
	Further Reading . . . . .	170
<b>7</b>	<b>Acid–Base Reactions . . . . .</b>	<b>173</b>
7.1	Acid–Base Reactions and the Proton Transfer . . . . .	173
7.2	Misconceptions. . . . .	175
7.3	Teaching and Learning Suggestions. . . . .	183
7.4	Experiments on Acids and Bases . . . . .	193
	References . . . . .	204
	Further Reading . . . . .	204
<b>8</b>	<b>Redox Reactions . . . . .</b>	<b>207</b>
8.1	Misconceptions. . . . .	209
8.2	Teaching and Learning Suggestions. . . . .	217
8.3	Experiments on Redox Reactions . . . . .	226
	References . . . . .	231
	Further Reading . . . . .	232
<b>9</b>	<b>Complex Reactions . . . . .</b>	<b>235</b>
9.1	Misconceptions. . . . .	237
9.2	Teaching and Learning Suggestions. . . . .	245

9.3 Experiments on Complex Reactions . . . . .	252
References . . . . .	259
<b>10 Energy . . . . .</b>	<b>261</b>
10.1 Misconceptions . . . . .	262
10.2 Empirical Research . . . . .	265
10.3 Energy and Temperature . . . . .	269
10.4 Fuel and Chemical Energy . . . . .	272
10.5 Experiments on Energy . . . . .	279
References . . . . .	286
Further Reading . . . . .	287
<b>List of Experiments . . . . .</b>	<b>289</b>
<b>Epilogue . . . . .</b>	<b>293</b>



<http://www.springer.com/978-3-540-70988-6>

Misconceptions in Chemistry

Addressing Perceptions in Chemical Education

Barke, H.-D.; Hazari, A.; Yitbarek, S.

2009, XI, 294 p., Hardcover

ISBN: 978-3-540-70988-6