

# **Contents**

<b>Foreword .....</b>	<b>xi</b>
<i>Gloria Ladson-Billings</i>	
<b>Preface .....</b>	<b>xix</b>
<b>CHAPTER 1 — Providing All Students with Access to Science .....</b>	<b>1</b>
Chapter Highlights .....	1
Replacing Stereotypes Regarding Science .....	2
The Worldview of Science .....	2
Science as the Work of “Figuring Things Out” .....	5
The Goal of Proficient Science Students .....	9
Diversity in Many Forms .....	11
Causes of Science Achievement Gaps .....	13
A Clearer Sense for Culture .....	15
A Broader View of Culture .....	20
Science as a Culture for Students .....	21
A Deep and Systemic Look .....	22
Chapter Summary .....	22
Key Terms .....	23
Suggested Readings .....	24
References .....	24

<b>CHAPTER 2 — Nature of Science: Seeing Science from a Bird’s Eye View .....</b>	<b>27</b>
Chapter Highlights .....	27
What Is the Nature of Science? .....	28
Unpacking Students’ Ideas about the Nature of Science.....	29
Characterizing the Actions of Science: Spheres of Activity and the Mangle of Practice .....	30
Spheres of Activity and Three-Dimensional Learning .....	32
Searching for a Functional Understanding of Scientific Practice .....	32
The Empirical Nature of Science .....	33
The Creativity of Science and Scientific Knowledge.....	34
Creativity and the Construction of Explanations.....	37
Science as a Social Enterprise.....	40
Scientific Knowledge is Open to Revision.....	41
Nature of Science and Diverse Classrooms: Science as a Way of Knowing .....	45
The Nature of Science and Science Teaching.....	48
Chapter Summary.....	49
Key Terms.....	49
Suggested Readings.....	50
References.....	50
<b>CHAPTER 3 — Science Activity: Collecting Information while Investigating .....</b>	<b>53</b>
Chapter Highlights .....	53
Teaching the Activities of Science .....	54
School Science in Transition .....	55
Observing.....	56
Observing and Asking Questions .....	59
Scientific Investigating by Professionals and Children.....	61
A Cultural Feature of Science: Classifying .....	62
Measuring within Investigating .....	64
Investigating: A Foundational Science Activity.....	65
Testing Our Understandings against the World .....	66
Benefits of Making Mistakes .....	68
Predicting and the Scientific Worldview.....	68
A Predicting Investigation.....	69
Chapter Summary.....	70
Key Terms.....	71
Suggested Readings.....	71
References.....	71
<b>CHAPTER 4 — Developing Explanations as a Science Activity.....</b>	<b>75</b>
Chapter Highlights .....	75
Conceptual Models.....	76
Science as an Academic Language .....	78
Scientific Sense-Making through Experimentation .....	79

Chapter Summary.....	96
Key Terms.....	97
Suggested Readings.....	98
Resources.....	98
References.....	98
<b>CHAPTER 5 — Using Theory to Explain and Understand Science Learning .....</b>	<b>101</b>
Chapter Highlights .....	101
What Counts as Learning? .....	102
Learning as the Personal Construction of Knowledge .....	112
Learning as the Social Construction of Knowledge .....	117
Learning Theory for Lifelong Learners .....	120
Chapter Summary.....	121
Key Terms.....	122
Suggested Readings.....	123
References.....	123
<b>CHAPTER 6 — Multiple Strategies to Assess Science Learning .....</b>	<b>127</b>
Chapter Highlights .....	127
Assessment in Broad Strokes .....	128
Assessing with Purpose .....	128
Types of Assessments .....	130
Formal Assessment.....	130
Informal Assessment .....	137
Aligning Assessments with the Curriculum .....	139
Interview as an Assessment Method.....	140
Chapter Summary.....	146
Key Terms.....	146
Suggested Readings.....	147
Web and Out-of-School Resources .....	147
References.....	148
<b>CHAPTER 7 — Questioning Strategies within Science Teaching .....</b>	<b>151</b>
Chapter Highlights .....	151
Behaviorism and Questioning .....	152
How to Ask Questions.....	156
Pulling Together the Pieces in a Diverse Classroom .....	166
Chapter Summary.....	170
Key Terms.....	170
Suggested Readings.....	171
References.....	171

<b>CHAPTER 8 — Varied Approaches to Science Instruction .....</b>	<b>173</b>
Chapter Highlights .....	173
Benefits from Science Learning .....	174
Teaching Science with the Discovery Approach .....	175
The Inquiry Approach to Science Teaching .....	179
Teaching Approaches as Attempts to Solve a Problem .....	181
Conceptual Change Approach to Science Teaching .....	183
Varying Science Approaches in Diverse Classrooms .....	187
Science as an Academic Language .....	190
Special Needs Populations and Science Teaching Approaches .....	191
Building an Instructional Sequence .....	192
The Learning Cycle: Combining Inductive with Deductive Teaching .....	197
Learning Cycle Teaching as Appropriate for All Students .....	201
Chapter Summary .....	202
Key Terms .....	203
Suggested Readings .....	204
References .....	204
<b>CHAPTER 9 — Engineering Design into Science Classrooms .....</b>	<b>207</b>
<i>Pamela S. Lottero-Perdue</i>	
Chapter Highlights .....	207
Unpacking Ideas about Technology and Engineering .....	208
Engineering's Distinct Practices .....	212
Engineering Habits of Mind .....	219
History and Culture of Engineering .....	222
Differentiating Science from Engineering .....	228
Supporting the Inclusion of Engineering in Science Education .....	233
Access to and Equity within Engineering .....	235
Implementing Engineering in Science Education .....	239
Curricular Resources, Approaches, and Tools for Engineering in Science Education .....	246
Assessing Engineering .....	256
Chapter Summary .....	260
Key Terms .....	261
Suggested Readings .....	262
Notes .....	263
References .....	263
<b>CHAPTER 10 — Managing Classrooms for Science Learning .....</b>	<b>269</b>
Chapter Highlights .....	269
Meeting Individual Needs .....	270
An Environment of Physical Safety .....	271
Teacher Knowledge Is the Key .....	276
Starting with Safety .....	277
Classroom Climate .....	278
Assessing the Classroom Environment .....	280

Cooperative Learning.....	282
English Language Learners and Managing a Productive Classroom.....	285
Birds of Similar Feathers.....	287
Chapter Summary.....	287
Key Terms.....	288
Suggested Reading.....	288
References.....	288
<b>CHAPTER 11 — Teachers Negotiating Different Communities.....</b>	<b>291</b>
Chapter Highlights .....	291
More than Just Methods .....	292
A Cautionary Note about Reaction to Difficulties.....	294
Negotiating Shifting Terrain.....	295
The Goal of Equitable Science Education.....	296
Common Barriers to Equitable Science Instruction .....	297
The Problem with Emphasizing Techniques .....	297
Equity Cannot Ignore or Deny Differences .....	299
Teachers Negotiating Various Communities.....	301
Negotiating the Community of Science .....	303
Negotiating Your Students' Communities.....	303
From Ideas to Actions .....	304
Helping Negotiate between Communities .....	306
The Classroom as a Community for Negotiation .....	307
Negotiating Your Own Communities .....	309
Realistic yet Ambitious Outlooks.....	313
Chapter Summary.....	313
Key Terms.....	314
Suggested Readings.....	314
References.....	315
<b>INDEX .....</b>	<b>317</b>