

Contents

Preface	vii
I Programs for Middle School Teachers	
A. Pre-service Training Programs	1
1 Preparing Middle Grades Mathematics Teachers at Georgia College & State University	
<i>Angel R. Abney, Nancy B. Mizelle, and Janet Shiver</i>	3
1.1 Introduction	3
1.2 Georgia College & State University	3
1.3 Middle Grades Program	4
1.4 Assessment	10
1.5 Teaching Certification	10
1.6 Conclusion	11
1.7 Bibliography	11
Appendix A: Chords of a Circle	12
2 The Mathematics for Middle School Teachers Program at Western Oregon University	
<i>Cheryl Beaver, Rachel Harrington, and Klay Kruczek</i>	15
2.1 Introduction	15
2.2 Background and Philosophy of the Program	15
2.3 Mathematics Course Requirements for Middle School Teachers	16
2.4 University and State Requirements	17
2.5 Comparison to Elementary and High School Requirements	18
2.6 Assessment	18
2.7 Conclusion	19
2.8 Bibliography	19
Appendix A: Courses for Middle School Teachers	19
Appendix B: Description of Foundation of Elementary Mathematics Series and Elementary Problem Solving courses	22
Appendix C: Comparative Summary of Mathematics Requirements	22
3 Connecting Middle School Mathematics with College Mathematics: A Core of Mathematics Courses for Middle Grade Mathematics Teachers	
<i>Ira J. Papick</i>	23
3.1 Introduction	23
3.2 Developing a Core Mathematics Curriculum for Middle Grade Teachers	24
3.3 Connecting Middle School Mathematics Curriculum with College-level Mathematics Content: Ex- amples from Algebra and Geometry	26
3.4 Effectiveness of Courses and Materials	27
3.5 Concluding Remarks	28

3.6	Bibliography	28
4	The Middle School Program at the University of Wisconsin Oshkosh	
	<i>Jennifer Szydlik, John Beam, Eric Kuennen, and Carol Seaman</i>	29
4.1	Introduction	29
4.2	The Context	30
4.3	The Middle School Program at UWO: An Overview	30
4.4	Philosophy	31
4.5	The Content Electives	31
4.6	The Capstone Course	33
4.7	Discussion	33
4.8	Bibliography	34
	B. In-service Training Programs	37
5	The Master of Arts in Middle School Mathematics Program at Salem (MA) State University	
	<i>Julie A. Belock</i>	39
5.1	Background: Teacher Licensure Requirements in Massachusetts	39
5.2	Origins of the Program	40
5.3	Program Requirements	41
5.4	The Mathematics Courses	42
5.5	What We Have Learned and What the Future Holds	42
5.6	Resources	44
5.7	Bibliography	44
	Appendix	45
6	The Math in the Middle Institute: Strengthening Middle Level Teachers' Mathematical and Pedagogical Capacities	
	<i>Ruth M. Heaton, W. James Lewis, and Wendy M. Smith</i>	47
6.1	The Institutional Context	47
6.2	The <i>Math in the Middle Institute</i> Partnership	48
6.3	The <i>Math in the Middle Institute</i>	49
6.4	Conclusion	53
6.5	Bibliography	54
	Appendix: Brief Descriptions of Math in the Middle Institute Courses	55
7	A Professional Development Program for Middle School Math Teachers in Maryland	
	<i>M. Elizabeth Mayfield and Christy Danko Graybeal</i>	59
7.1	Introduction	59
7.2	Background and History	59
7.3	A Master's Program in Mathematics Education for Middle School Teachers	60
7.4	Goals	60
7.5	Required Courses	60
7.6	Algebra and Geometry for Middle School Teachers	61
7.7	Other Mathematics Education Programs	62
7.8	Challenges and Solutions	63
7.9	Assessment, and the Future of the Program	63
7.10	Bibliography	65
	Appendix: Course Descriptions	66

II Courses for Middle School Teachers

A. Discrete Mathematics 69

8 Discrete Mathematics: A Course in Problem Solving for 21st Century Middle School Teachers

Tanya Cofer, Valerie A. DeBellis, Cathy Liebars, Joseph G. Rosenstein, Bonnie Saunders, and Margaret Wirth **71**

8.1 Introduction 71

8.2 Background 71

8.3 The Course Materials: *Making Math Engaging Curriculum* 73

8.4 Examples of Course Content 73

8.5 Course Formats of Established Discrete Mathematics Courses for Middle School Teachers 77

8.6 Conclusion 82

8.7 Bibliography 82

9 Guided Discovery in a Discrete Mathematics Course for Middle School Teachers

Mary Flahive and Reva Kasman **85**

9.1 Introduction 85

9.2 Course Materials 85

9.3 Course Structure 88

9.4 Establishing the Class Format 90

9.5 Concrete Contexts for Abstract Notions 91

9.6 The Student Experience 93

9.7 Accessing Resources 94

9.8 Concluding Remarks 94

9.9 Bibliography 94

Appendix: Table of Contents for the Course Notes 95

B. Geometry 97

10 Geometry for Middle Grades Teachers at Northern Kentucky University

Bethany Noblitt **99**

10.1 History and Philosophy of the Course 99

10.2 Prerequisites 100

10.3 Learning Objectives 100

10.4 A Typical Class Meeting 100

10.5 Content 101

10.6 Assessment 109

10.7 Assignments and Projects 110

10.8 Conclusion 110

10.9 Bibliography 111

Appendix A: Additional Activities 111

Appendix B: Syllabus 113

C. Number Theory and Abstract Algebra 117

11 A Number and Algebra Course for Middle School Math Teachers

Michael Mays and David Miller **119**

11.1 Introduction 119

11.2 History and Background 120

11.3 Detailed Course Outline 121

11.4 Sample Vignettes 125

11.5	Sample Resources	128
11.6	Remarks on On-line Instruction and Resources Available	130
11.7	Bibliography	130
D. Precalculus and Calculus		133
12	Vertically Connecting Precalculus and Calculus with Middle School Mathematics	
	<i>Theresa Jorgensen</i>	135
12.1	Format of the Courses	136
12.2	Course Content	136
12.3	Essential Course Elements	137
12.4	Concluding Remarks	141
12.5	Bibliography	142
13	Visual College Algebra for Teachers	
	<i>Laurie J. Burton and Klay T. Kruczek</i>	143
13.1	Active Learning Approach	144
13.2	The Visual Algebra for College Students Materials	144
13.3	Sample Activities	145
13.4	Assessment of Students	151
13.5	Assessment of Course	152
13.6	Concluding Remarks	152
13.7	Bibliography	153
E. Probability and Statistics		155
14	Probability and Statistics for Prospective Middle Grades Teachers	
	<i>Jennifer Szydlak, John Beam, Eric Kuennen, and Carol Seaman</i>	157
14.1	Introduction	157
14.2	Class Activities	158
14.3	Read and Study	159
14.4	Connections to the Middle Grades	159
14.5	Homework	160
14.6	Class Projects	162
14.7	Assessment	162
14.8	Discussion	163
14.9	Conclusion	163
14.10	Bibliography	163
	Appendix A: List of Topics for Big Ideas in Probability and Statistics	164
	Appendix B: Fall 2009 Course Syllabus for Big Ideas in Probability and Statistics	165
F. Combination Courses		167
15	Vermont Middle Level Mathematics Initiative: Courses and Materials for Mathematics Educators	
	<i>George Ashline and Marny Frantz</i>	169
15.1	Introduction	169
15.2	Course Structure and Course Content	170
15.3	Essential Course Elements	172
15.4	Conclusion	177
15.5	Bibliography	178

Appendix: Formative Assessment Strategies 179

16 Challenging Yet Accessible Mathematics Courses for Middle Level Teachers

Ruth M. Heaton, W. James Lewis, Michelle R. Homp, Steven R. Dunbar, and Wendy M. Smith **181**

16.1 Mathematics as a Second Language 182

16.2 Experimentation, Conjecture, and Reasoning for Middle Level Teachers 185

16.3 Number Theory and Cryptology for Middle Level Teachers 188

16.4 Mathematical Growth Across Courses 190

16.5 Conclusion 192

16.6 Bibliography 192

Appendix A: Mathematics as a Second Language Course Outline 193

Appendix B: Experimentation, Conjecture, and Reasoning Course Outline 194

Appendix C: Experimentation, Conjecture, and Reasoning Instructor Notes 195

Appendix D: Experimentation, Conjecture and Reasoning Syllabus 197

Appendix E: Number Theory and Cryptology for Middle Level Teachers Course Outline 201

Appendix F: Number Theory and Cryptology for Middle Level Teachers Instructor Notes 201