## CONTENTS

**Acknowledgements**   iii

**Introduction**  1  
Background  1  
Vision for Scientific Literacy  1  
The Vision of *Senior 3 Physics: A Foundation for Implementation*  2  
Goals for Canadian Science Education  2  
Beliefs about Learning, Teaching, and Assessing Science  2  
Changing Emphases in Science Education Content Delivery  3  
Changing Emphases to Promote Inquiry  3  

**Section 1: Manitoba Foundations for Scientific Literacy**  
The Five Foundations  3  
Nature of Science and Technology  4  
Science, Technology, Society, and the Environment (STSE)  6  
Scientific and Technological Skills and Attitudes  9  
Essential Science Knowledge  12  
The Unifying Concepts  14  
Kindergarten to Senior 2 Topic Chart  16  

**Section 2: Implementation**  
The Senior Years Student and the Science Learning Environment  3  
Characteristics of Senior 3 Learners  3  
Effective Teaching in Physics: What the Research Says to Teachers  14  
Unit Development in Physics  16  
A View of Physics Education: Toward Modes of Representation  17  
The Modes of Representation  18  
The Importance of the Modes of Representation  21  
Toward an Instructional Philosophy in Physics  23  

**Section 3: Assessment in Senior 3 Physics**  
Characteristics of Effective Assessment  4  
Types of Assessment  10  
Assessment Strategies  11
Section 4: Document Organization

Guide to Reading Specific Learning Outcomes and Document Format  3
Document Format  4
Guide to Reading Specific Learning Outcomes  6
Overview  7

Topic 1: Waves

Topic 2: The Nature of Light

Topic 3: Mechanics

Topic 4: Fields

Appendices

Appendix 1: Waves
  1.1: Strobe Template  3
  1.2: Concept Map for Wave Equation Variables  4
  1.3: Superposition of Waves  5
  1.4: Waves in One Dimension  7
  1.5: Derivation of Snell’s Law  11
  1.6: Circular Wave Patterns  14
  1.7: Interference Pattern from Two Point Sources  16
  1.8: Moiré Patterns  17
  1.9: Data Table for Speed of Sound  19
  1.10 Sound Intensity Levels Table  20

Appendix 2: The Nature of Light
  2.1: Wave-Particle Model of Light—Models, Laws, and Theories  21
  2.2: The Mystery Container  24
  2.3: Astronomy with a Stick  26
  2.4: Chart for Evaluating the Models of Light  27
  2.5: Jupiter and Its Moon Io  28
  2.6: Ole Christensen Rømer: The First Determination of the Finite Nature of the Speed of Light  29
  2.7: Ole Rømer and the Determination of the Speed of Light  32
  2.8: Why Were Eclipse Events at Jupiter Important to 17th-Century Science?  42
  2.9: Becoming Familiar with Ionian Eclipses  43
  2.10: Simulating Reemer’s Eclipse Timings Using Starry Night Backyard  47
  2.11: Contributions to the Determination of the Speed of Light  55
Appendix 3: Mechanics
3.1: Working with the Modes of Representation 57
3.2: A Vector Journey 59
3.3: Journal Entry on Vectors 61
3.4: A Vector Sampler 62
3.5: Analysis of Data Using Microsoft Excel 63
3.6: Describing Motion in Various Ways 66
3.7: Introducing Motion: Position, Time, Distance and Speed, Displacement, and Velocity 68
3.8: Motion: Interpreting Position-Time Graphs 78
3.9: Journal Entry: Kinematics (Position and Velocity) 84
3.10: Kinematics: Position, Velocity, and Acceleration Graphs 87
3.11: Kinematics and Graphing Skills Builder 89
3.12: Kinematics: Position, Velocity, and Acceleration Graphs, and Their Equations 91
3.13: Kinematics Sampler: Graphs, Equations, and Problem Solving 93
3.14: Kinematics Graphs Transformation Organizer 98
3.15: Journal Entry: Dynamics and Diagrams 99
3.16: Free-Body Diagrams: Linear Motion 101
3.17: Free-Body Diagrams 2: Linear Motion 102

Appendix 4: Fields
4.1: Vertical Motion at the Earth's Surface 103
4.2: Journal Entry: Gravitational Fields 105
4.3: Student Sampler: Magnetic Fields 106
4.4: Student Article Analysis—Scientific Fraud? 108
4.5: William Gilbert and the Earth's Magnetic Field 114

Appendix 5: Developing Assessment Rubrics in Science
The Nature, Purpose, and Sources of Assessment Rubrics for Science 121
Developing Rubrics in Collaboration with Students 124
Appendix 6: Assessment Rubrics
Rubric for the Assessment of Class Presentations  129
Rubric for the Assessment of a Research Project  130
Rubric for the Assessment of a Decision-Making Process Activity  131
Lab Report Assessment  133
Observation Checklist—Scientific Inquiry: Conducting a Fair Test  134
Rubric for Student Presentation  135
Rubric for Research Skills  136

Appendix 7: General Learning Outcomes  137

Bibliography