

# 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 Rømer'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**