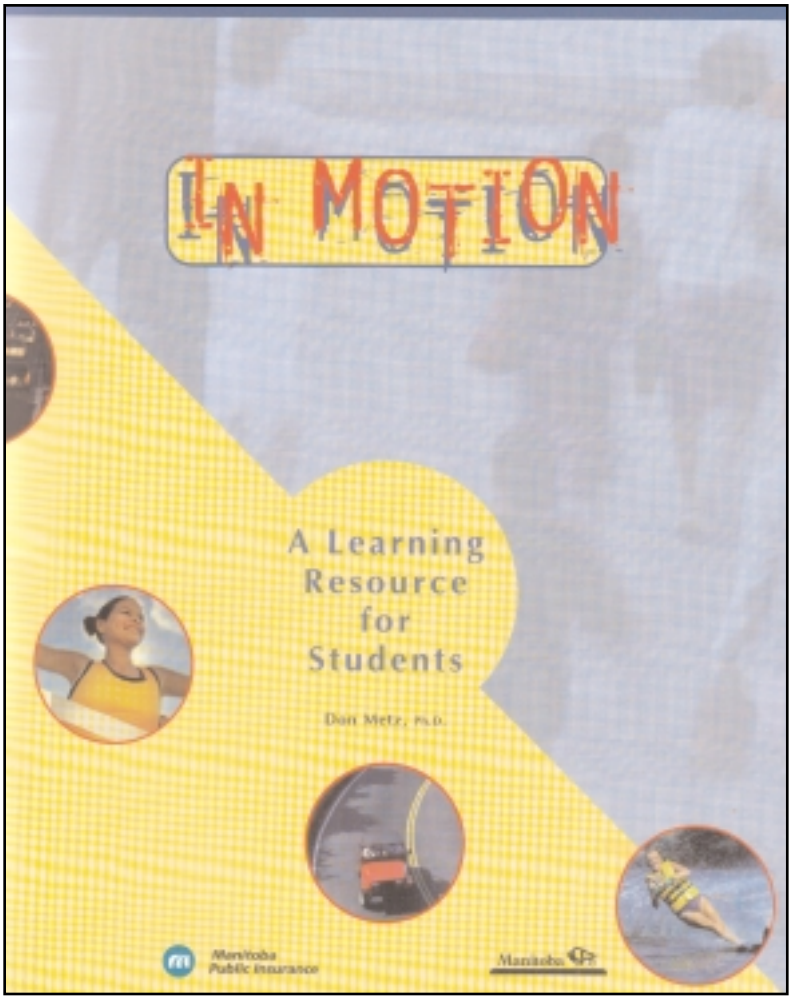
Senior 2

Appendix 7:
In Motion—Teacher Resource Guide



Preface

This resource material is based on actual teacher experiences in Senior 2 Science (20F) classrooms. Therefore, the results of the student learning activities act as summaries of students' results. In many cases, the student-generated inquiry results do not coincide in a precise manner with predicted or theoretical results. This is positive insofar as it brings to light the difficulties in attempting to understand ideal situations from less than ideal (or controlled) circumstances. In a very real sense, this acts as a preliminary view through a window that looks at the nature of scientific inquiry. Inquiry in science, including high-grade research, is often less than tidy. In the cases presented here with students, sources of systematic or procedural error were actively sought, and suggestions were made for correcting or accounting for these errors.

Students are not required to do all the suggested activities and/or respond to all questions presented in the module. The most important consideration is recognizing that achievement of the specific learning outcomes for the *In Motion* thematic cluster is possible through in-depth use of this resource in the classroom. Moreover, it is estimated that approximately 30 to 40 hours would be required to complete the *In Motion* booklet if every student activity were to be addressed. Since time allotments suggest approximately 25 hours to complete this cluster, teachers are encouraged to be strategic in their selection of which activities to do with their students. Again, the primary focus in using this classroom-based resource rests in achieving the specific learning outcomes as outlined in *Senior 2 Science: A Foundation for Implementation*.

The mathematical connections to the content are an important component of the instructional design process that underpins *In Motion — A Student Learning Resource*. Teachers may wish to consult details of appropriate mathematical treatment for students at this grade level as contained in the Modes of Representation section of *Senior 2 Science: A Foundation for Implementation*. The gathering and subsequent analysis of the data is generally done manually by the students, through hand-drawn graphing techniques, calculation of slopes, and discussion of the results. If the opportunity exists, and equipment is available, some time could be saved through the use of Calculator-Based Laboratory (CBL) tools and probe connections to graphing calculators. Another alternative is for the students to perform some activities "virtually" in an Internet browser, using Java applets, which are readily available on the web. This teacher resource has selected a number of effective examples of these applets, and includes them in the Webquest chapter.

Most of the sections of *In Motion* can be taught as presented in the student learning resource. The booklet closely reflects the specific learning outcomes of the In Motion cluster of Senior 2 Science (20F), with virtually complete coverage of the student activities that are recommended in the *Foundation for Implementation*. In the case of Chapter 2: Analyzing Motion, considerable work has been provided as alternate material for the development of the relationships among position, displacement, velocity, acceleration, and time. These alternate materials are not prescriptive, but are examples of one instructional design approach, starting

with concrete experiences of the student, then building toward the more abstract concepts. In a sense, this approach is a *scaffolding* for students, taking them in identifiable steps towards increased sophistication of treatment. These motion concepts could be applied in a variety of situations, and consequently a variety of student activity sheets, along with the answers, have been supplied.

Students often struggle somewhat with the concepts related to Newton's Laws, momentum, impulse, and energy. These are treated more conceptually at Senior 2 than in an exclusively symbolic (mathematical) treatment common at advanced levels of the study of physics. Students may have some difficulty in applying the motion ideas conceptually to actual problems requiring explanations. Some differentiation of instruction is recommended for these topics, and suggestions and strategies are included.

Generally, the students will enjoy doing the activities. The Great Egg Drop Competition and the Rocket Car activities are often very well received. Most of the activities can be completed with equipment found in high school physics laboratories. Very little in the way of new equipment is required. CBL units and graphing calculators should be available from the mathematics department in your school, as these are used regularly in Senior 2 Applied Mathematics (20S).

Overall, *In Motion — A Student Learning Resource* was conceived to address the specific learning outcomes across all levels of student ability. It can be modified and enriched with ease to stimulate the gifted student, and it can also be adapted to meet the needs of those who may be struggling. Teachers are encouraged during the first years of implementation, as with any new course, to find out what works, what does not work, what needs to be changed, and how to adapt to the needs of those students in the local environment. Readily available science and physics textbooks, together with many resources on the Internet, can provide a wealth of supplementary aids for the Senior 2 classroom teacher.

Note: There are some errors in the reference. These have been acknowledged as errata in the appropriate chapter and section.