

Introduction

“Ask not what a computer can do to students, but what students can do with a computer.”
— David Thornburg

BACKGROUND: AN INTERDISCIPLINARY INSTRUCTIONAL APPROACH

Integrating Foundation Skill Areas

To help prepare students for their roles in society, Manitoba Education, Citizenship and Youth has identified technology, literacy and communication, problem solving, and human relations as foundation skill areas to be developed within the context of every subject area from Kindergarten to Senior 4 (see Manitoba Education and Training, *A Foundation for Excellence*). Traditionally, the core function of schools has been to teach students key content and skills such as reading, writing, and numeracy. Today, students also require enhanced knowledge, skills, and strategies that will allow them to respond to changing ideas and attitudes in the evolution of their communities and of their world.

In response to this direction, the Department has produced several documents, including the following:

- Manitoba Education and Training. *Curricular Connections: Elements of Integration in the Classroom*. Winnipeg, MB: Manitoba Education and Training, 1997. This document encourages the acquisition of knowledge, skills, and strategies through an interdisciplinary approach to learning and teaching.
- ---. *Technology As a Foundation Skill Area: A Journey toward Information Technology Literacy: A Resource for Curriculum Developers, Teachers, and Administrators*. Winnipeg, MB: Manitoba Education and Training, 1998. This resource encourages the development of information technology literacy as well as curricular knowledge, skills, and strategies through the integration of information and communication technologies into curricula.

Together, these approaches can enable students to solve problems, to improve their personal performance, and to gain the critical and abstract thinking skills necessary to become lifelong learners and contributing members of their communities.

In addition to integrating foundation skill areas, curriculum documents are to incorporate the following elements:

- foundation skill areas
- resource-based learning
- differentiated instruction
- curricular integration
- Aboriginal perspectives
- gender fairness
- appropriate age portrayals
- human diversity
- anti-racist/anti-bias education
- sustainable development

For additional information on departmental policy regarding the elements of integration, refer to *A Foundation for Excellence* (Manitoba Education and Training 16-21).

Integrating Curricula with Information and Communication Technologies

Manitoba Education, Citizenship and Youth established the Interdisciplinary Middle Years Multimedia (IMYM) Project in 1996 to develop models of interdisciplinary units that integrate the

use of information and communication technologies (ICTs) for learning, teaching, and assessment in the core subject areas (English language arts, mathematics, science, and social studies) at each grade from Grades 5 to 8. (For additional information, see the Department's IMYM website at: <<http://www.edu.gov.mb.ca/ks4/tech/imym/>>.)

The Grade 6 *Inventions, Innovations, and Discoveries* unit was produced through the IMYM Project. This unit was originally written by a development team of five Manitoba Grade 6 teachers and piloted by 26 IMYM schools.

The creation and promotion of student inventions was chosen as the real-world context for integrating the four core subject areas: English language arts, mathematics, science, and social studies, using the interdisciplinary theme of *Inventions, Innovations, and Discoveries*. Whenever possible, two or more subject areas are combined within a single learning experience to help students achieve several learning outcomes simultaneously.

The use of ICTs in the IMYM Project facilitates curriculum integration and allows students to develop the ICT literacy skills and competencies necessary to function in today's society. The use of ICTs allows Middle Years students to

- develop knowledge, ability, and responsibility in the use of information technology
- acquire, organize, analyze, evaluate, and present information using appropriate information technology
- use information technology to expand the range and effectiveness of communication
- solve problems, accomplish tasks, and express creativity, both individually and collaboratively, using information technology
- understand the role and impact of information technology, and apply ethical, responsible, and legal standards in its use

Within the *Inventions, Innovations, and Discoveries* unit, learning becomes more meaningful for students as their teachers work with them to draw connections among four interdependent subject areas. Making these connections not only requires the use of higher level thinking skills such as problem solving and critical analysis (see Manitoba Education and Training, *A Thinking Framework: Teaching Thinking across the Curriculum*), but also promotes flexible, divergent thinking, and a broad interdisciplinary understanding. These skills support students as they think across subject areas while attempting to analyze social and technological problems. The development of technology as a foundation skill area, through direct interdisciplinary integration, enables students to use ICTs to

- learn
- enhance understanding of the connections among technology, society, and the environment
- become active problem solvers

Differentiating Instruction

The integration of ICTs within *Inventions, Innovations, and Discoveries* helps address students' varying approaches to learning and thinking, and takes into consideration multiple intelligences. For a further discussion of learning and thinking approaches and multiple intelligences, see the following departmental publications:

- Manitoba Education and Training. *Success for All Learners: A Handbook on Differentiating Instruction: A Resource for Kindergarten to Senior 4 Schools*. Winnipeg, MB: Manitoba Education and Training, 1996. (See Chapter 4.)
- ---. *Grades 5 to 8 English Language Arts: A Foundation for Implementation*. Winnipeg, MB: Manitoba Education and Training, 1998. (See Appendix B.)

Throughout this interdisciplinary unit, learning experiences that integrate ICTs are designed to take into consideration any or all intelligences as identified by Howard Gardner (cited in Checkley):

- verbal/linguistic
- visual/spatial
- logical/mathematical
- body/kinesthetic
- musical/rhythmic
- interpersonal/social
- intrapersonal/introspective
- naturalist

Word processing, for example, requires a certain level of verbal/linguistic intelligence. Use of draw and paint software, on the other hand, more often requires visual/spatial intelligence. Perhaps the most exciting ICT applications in *Inventions, Innovations, and Discoveries* involving multiple intelligences are multimedia authoring projects or web page authoring projects. Multimedia and web-based projects that incorporate text (verbal/linguistic intelligence), illustrations (visual/spatial), sounds (musical/rhythmic or verbal/linguistic), and video (body/kinesthetic) can be developed by and/or for individual students or groups of students.

Students can also use multimedia and web page authoring applications to create electronic collections and portfolios. Students share their electronic collections with their parents/guardians and peers as evidence of their increasing competencies. Teachers may use these portfolios as part of an authentic assessment of student progress and achievement during a semester or school year (see Manitoba Education and Training, *Reporting on Student Progress and Achievement: A Policy Handbook for Teachers, Administrators, and Parents*).

Integrating Aboriginal Perspectives and Sustainable Development

In addition to integrating requisite curricular components, ICTs, and suggestions for differentiating instruction and assessment, this interdisciplinary unit incorporates Aboriginal perspectives and elements of sustainable development:

- **Aboriginal Perspectives:** Many learning experiences include suggestions to extend student learning, for example, by finding out that Aboriginal people invented tools such as snowshoes to respond to their needs. (See Manitoba Education and Youth, *Integrating Aboriginal Perspectives into Curricula: A Resource for Curriculum Developers, Teachers, and Administrators*.)
- **Sustainable Development:** Through a consensus-based decision-making process, students develop their understanding of how inventions, innovations, and discoveries can affect the economy, environment, and society so that each can be sustained for future generations. (See Manitoba Education and Training, *Education for a Sustainable Future: A Resource for Curriculum Developers, Teachers, and Administrators*.)

DEVELOPMENT OF THE GRADE 6 INTERDISCIPLINARY UNIT USING CONCEPTS

Manitoba's current Grade 6 core curriculum documents and *Technology As a Foundation Skill Area* (hereafter abbreviated as TFS) provided the content and pedagogical basis for *Inventions, Innovations, and Discoveries*. The Association for Supervision and Curriculum Development (ASCD) video *Planning Integrated Units: A Concept-Based Approach* (Erickson), available from the Department's Instructional Resources Unit (IRU) Library, provided guidance in the process of selecting a conceptual theme.

The key stages in planning a concept-based, multimedia-integrated, interdisciplinary unit are summarized in Table 1.

Table 1: Developing the IMYM6 Unit Using Concepts

Resources	Process	Result
<ul style="list-style-type: none"> Provincial core curriculum documents TFS document ASCD video Discussion 	<p>Identify a Conceptual Theme</p> <ul style="list-style-type: none"> Identify an overarching theme that takes into account the educational perspective of each core subject area, the foundation skills, and the elements of integration. 	<ul style="list-style-type: none"> <i>Inventions, Innovations, and Discoveries</i>
<ul style="list-style-type: none"> Grade 6 core curriculum documents 	<p>Identify the Major Concepts</p> <ul style="list-style-type: none"> A concept is an organizing idea (e.g., symmetry, conflict, force, needs). A concept belongs to a core subject area. Knowledge of the curriculum for a grade is essential in identifying a major concept. 	<ul style="list-style-type: none"> English Language Arts: Communication Mathematics: Change Science: Improvement Social Studies: Human Needs
	<p>Write Essential Understandings</p> <ul style="list-style-type: none"> Essential understandings (generalizations) synthesize ideas to show an important relationship, usually by combining two or more concepts. Essential understandings are summaries of what students should understand as a result of the unit. 	
<ul style="list-style-type: none"> Framework of Outcomes Foundation for Implementation 	<p>Identify Topics within Each Core Subject Area</p> <ul style="list-style-type: none"> With the help of the Framework of Outcomes and Foundation for Implementation documents, identify which topics are suitable for an integrated unit. 	<ul style="list-style-type: none"> English Language Arts: All Five General Learning Outcomes (GLOs) Mathematics: Data Analysis Science: Electricity Social Studies: Canada: A Country of Change (1867 to Present)
	<p>Formulate Guiding Questions</p> <ul style="list-style-type: none"> Guiding questions combine specific “what” questions related to a particular theme with open-ended “why” and “how” questions to develop conceptual thinking and deep understanding. 	<ul style="list-style-type: none"> See Appendix A
	<p>Identify Processes and Skills Students Need</p>	<ul style="list-style-type: none"> Ongoing Learning Experiences (OLEs) Information and Communication Technologies (ICTs)
	<p>Identify the Culminating Performance Task</p> <ul style="list-style-type: none"> The Culminating Performance Task can be used to assess and evaluate what students know, understand, and can do as a result of participating in the unit of study. 	<ul style="list-style-type: none"> Student As Inventor
<ul style="list-style-type: none"> IMYM6 Development Team 	<p>Write Interdisciplinary Unit</p> <ul style="list-style-type: none"> Instructional strategies should address the essential questions and skills. 	
<ul style="list-style-type: none"> Pilot Teachers 	<p>Pilot the Unit</p>	<ul style="list-style-type: none"> Feedback from pilot teachers
<ul style="list-style-type: none"> Project Team 	<p>Revise the Unit</p>	<ul style="list-style-type: none"> Revised unit available online and on CD-ROM

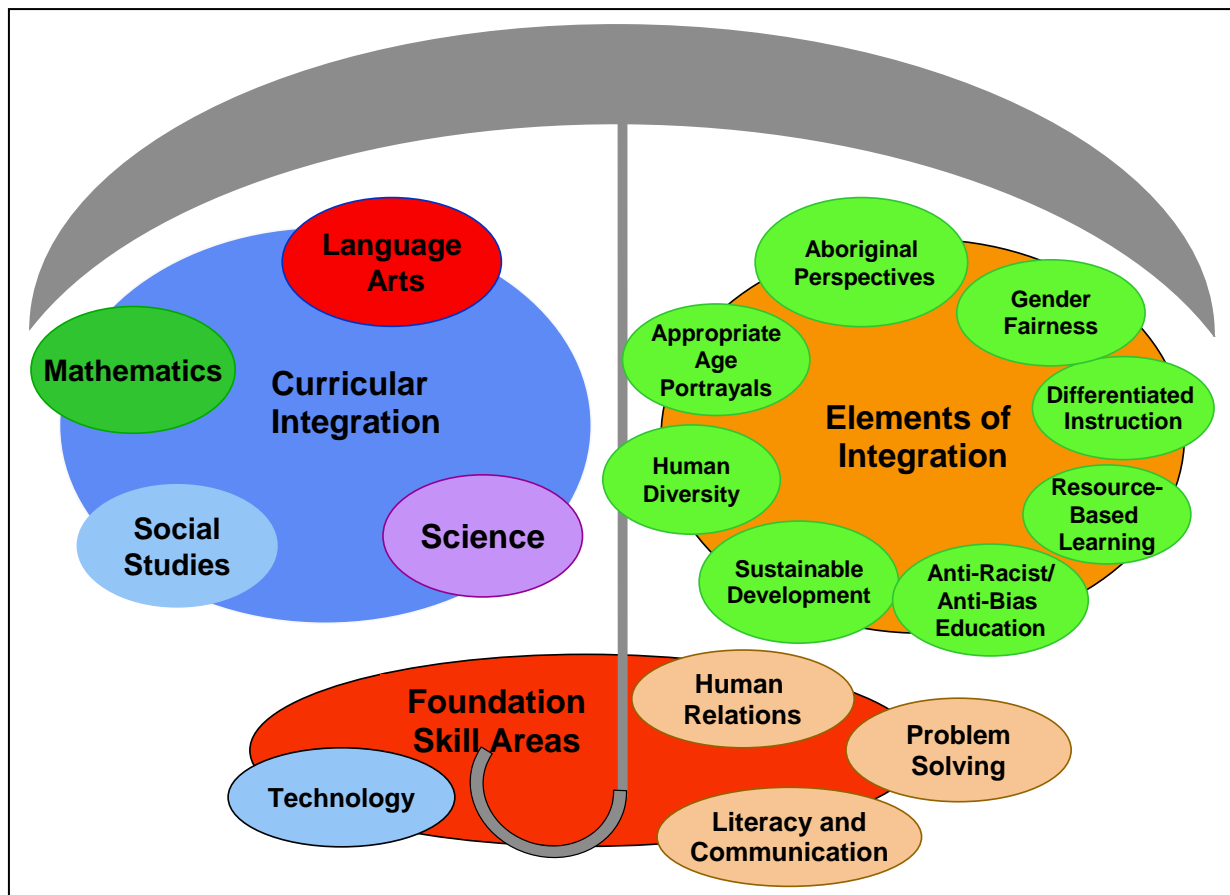
Conceptual Theme

The first step in planning an interdisciplinary unit for Grade 6 was identifying a conceptual theme. Departmental documents were reviewed to take into account the various educational perspectives of

- curricular integration (core subject areas)
- foundation skill areas
- elements of integration

Through this process, *Inventions, Innovations, and Discoveries* was identified as the theme for IMYM6, as shown in Table 2.

Table 2: Educational Perspectives in Planning Conceptual Theme for *Inventions, Innovations, and Discoveries*



Major Concepts

Major concepts can often be transferred within and between disciplines and beyond the classroom to everyday life. Many congruent concepts were identified within Manitoba's Grade 6 core curriculum to support the theme of *Inventions, Innovations, and Discoveries*. The four major concepts chosen for exploring the conceptual theme of *Inventions, Innovations, and Discoveries* within the core subject areas were:

- English Language Arts: *Communication*
- Mathematics: *Change*
- Science: *Improvement*
- Social Studies: *Human Needs*

Essential Understandings and Guiding Questions

The IMYM6 development team explored the question of which topics within each core subject area would act as lenses to focus the conceptual theme on the four major concepts. Topics that could integrate the conceptual theme within each core subject area were identified using a concept-mapping strategy. The following topics were identified:

- English Language Arts: *All five GLOs*
- Mathematics: *Data Analysis*
- Science: *Electricity*
- Social Studies: *Canada: A Country of Change (1867 to Present)*

Using these topics, the development team began the process of writing essential understandings (generalizations). Guiding questions were then formulated from the essential understandings. Care was given to prepare a combination of specific “what” questions with open-ended “why” and “how” questions that promote higher-level thinking. The complete list of essential understandings and guiding questions is found in Appendix A: Essential Understandings and Guiding Questions.

Key Skills and Processes

Using the provincial curriculum and support documents (see the list of Departmental Publications in Selected Bibliography), the development team identified the complex performances (processes) and key skills required by students throughout the unit. The context for learning these key skills and processes is presented in the Ongoing Learning Experiences (OLEs) and the Introductory Information and Communication Technology (ICT) Learning Experiences components of the *Inventions, Innovations, and Discoveries* interdisciplinary unit.

Culminating Performance Task

When deciding on a culminating performance task, the IMYM6 development team wanted to provide suggestions for a student-created product that would be used to assess and evaluate what students know, understand, and can do as a result of participating in the *Inventions, Innovations, and Discoveries* interdisciplinary unit. Consideration was also given to the practical performance of these skills. The team chose the concept of “Student As Inventor” as the culminating performance task, allowing students to demonstrate authentic application of the knowledge, skills, and processes acquired throughout the *Inventions, Innovations, and Discoveries* interdisciplinary unit. Learning experiences in the four modules of the unit help students develop useful skills and provide information that enables students to become successful “inventors.” During Module 4: Invention Convention: The Student As Inventor, student groups take on the role of inventors.

Learning Experiences

The guiding questions and the complex performances that were identified for the *Inventions, Innovations, and Discoveries* interdisciplinary unit led to the creation of the learning experiences for the unit. Through the learning experiences, students find answers to the guiding questions, develop skills in the foundation areas, and meet curricular outcomes. Furthermore, as students grasp the essential understandings, they demonstrate their comprehension of the conceptual theme through completion of Module 4: Invention Convention: The Student As Inventor.

CONTENT AND ORGANIZATION OF INVENTIONS, INNOVATIONS, AND DISCOVERIES

Unit Design

The Grade 6 Interdisciplinary Middle Years Multimedia (IMYM6) unit is designed so that core subject areas are woven around an interdisciplinary conceptual theme focused on a real-world context. *Inventions, Innovations, and Discoveries* places teams of students in the role of inventors whose task is to survey the needs of people in their home, school, or community, create an invention to meet those needs, and then to promote their invention. Students present the results of their research and creation in the form of an Invention Convention.

The *Inventions, Innovations, and Discoveries* unit consists of four instructional components, as indicated in Table 3.

Table 3: Instructional Components of *Inventions, Innovations, and Discoveries*

<p>Ongoing Learning Experiences (OLEs)</p> <p>OLEs are daily, weekly, and monthly learning experiences that begin in September of a school year, and continue throughout the unit, as well as throughout the year.</p>	<p>Introductory Information and Communication Technology (ICT) Learning Experiences</p> <p>ICTs familiarize teachers and students with the capabilities of each type of hardware and software in the context of core curriculum topics and/or the <i>Inventions, Innovations, and Discoveries</i> interdisciplinary unit.</p>
	<p><i>Inventions, Innovations, and Discoveries</i></p>
	<p>Modules 1 to 3</p> <p>The first three modules provide real-world learning experiences that prepare students to plan their inventions.</p>
	<p>Module 4: Invention Convention: The Student As Inventor</p> <p>The last module provides the culminating performance task of creating an invention and marketing it for the <i>Inventions, Innovations, and Discoveries</i> interdisciplinary unit at an Invention Convention.</p>

Unit Organization

Teachers begin the *Inventions, Innovations, and Discoveries* unit at the start of a school year by introducing the OLEs as part of a classroom routine that will continue throughout the year. At the same time, teachers introduce the various hardware and software components, taking into consideration students' prior knowledge, by introducing ICT learning experiences in the context of core curricular topics included within the *Inventions, Innovations, and Discoveries* modules or any other unit of study in the classroom. It is suggested that the OLE and ICT learning experiences be introduced from September to December of a given school year.

Teachers may proceed with the *Inventions, Innovations, and Discoveries* interdisciplinary unit itself (Modules 1 to 4) at any point during the school year; however, it is suggested that teachers allow for a six- to eight-week timeframe that is uninterrupted by ongoing events or school breaks. January to March offers such an interval.

In January of a school year, teachers familiarize students with the purpose of the interdisciplinary unit by introducing Module 1: What Does It Mean? An Introduction to *Inventions, Innovations, and Discoveries*. Students plan their inventions in Module 2: Explain That Again: A Further Investigation and Module 3: Explore Electricity: The Backbone of Modern Inventions. Modules 2 and 3 are introduced simultaneously in order that Module 3 can be addressed within an authentic context. The unit concludes with Module 4: Invention Convention: The Student As Inventor when students create and present their inventions.

The instructional strategies allow modules to be run in learning centres (see Instructional Model section of this Introduction), set up according to teacher preference, class size, classroom environment, or resources in formats such as the following:

- six concurrently running groups
- two sets of three concurrently running groups
- three sets of two concurrently running groups

Throughout the learning centre work, students conduct research that assists them in becoming inventors. While students rotate through the learning centres, they refine their invention results and present them on their Inventions section of their classroom website.

All components of the *Inventions, Innovations, and Discoveries* interdisciplinary unit contain a number of learning experiences, as shown in Table 4.

Table 4: Overview of *Inventions, Innovations, and Discoveries*

<p>Ongoing Learning Experiences (OLEs)</p> <p>OLE.1: Personal Binder Reminder</p> <p>OLE.2: Daily Edit</p> <p>OLE.3: Daily Math and Problem Solving</p> <p>OLE.4: Reading Circles</p> <p>OLE.5: Share the Learning</p> <p>OLE.6: Collaborative Learning</p> <p>OLE.7: Speak Ye! Hear Ye!</p> <p>OLE.8: Reflection Journal</p> <p>OLE.9: Newspapers</p> <p>OLE.10: Electronic Collection</p>	<p>Introductory Information and Communication Technology (ICT) Learning Experiences</p> <p>ICT.1: Toolbox Binder</p> <p>ICT.2: Write This Down (Word Processing)</p> <p>ICT.3: Riddle This (Email)</p> <p>ICT.4: Looks Like This (Graphics: Paint/Draw)</p> <p>ICT.5: Roam Your ROM (CD-ROMs)</p> <p>ICT.6: Inspired (Concept Mapping)</p> <p>ICT.7: Caught in Action (Digital Camera/Video)</p> <p>ICT.8: Make Your Point (Multimedia)</p> <p>ICT.9: Look for It: Learning to Search the Internet (Internet #1)</p> <p>ICT.10: Find It: Internet Scavenger Hunt (Internet #2)</p> <p>ICT.11: Make It: Creating an Effective Web Page (Internet #3)</p> <p>ICT.12: Chart This (Spreadsheet)</p>	
	<p>Module 1: What Does It Mean? An Introduction to <i>Inventions, Innovations, and Discoveries</i></p> <p>Mod.1.1: What on Earth?</p> <p>Mod.1.2: What Do I Know?</p> <p>Mod.1.3a: Back to the Future: A Timeline of Discoveries</p> <p>Mod.1.3b: Why Do We Invent?</p> <p>Mod.1.3c: Then and Now: Advances in Computer Technology</p>	
	<p>Module 2: Explain That Again: A Further Investigation</p> <p>Mod.2.1: Extra! Extra! Read All about It</p> <p>Mod.2.2: Biography of an Inventor or a Scientist</p> <p>Mod.2.3: Rube Goldberg</p> <p>Mod.2.4: Chindogu: Useless Inventions</p> <p>Mod.2.5: Tally-Ho</p> <p>Mod.2.6: Customer Service Department</p>	<p>Module 3: Explore Electricity: The Backbone of Modern Inventions</p> <p>Mod.3.1: Static Electricity</p> <p>Mod.3.2: Current Electricity</p> <p>Mod.3.3: Electrical Circuits</p> <p>Mod.3.4: Electromagnetism</p> <p>Mod.3.5: Awareness of Electrical Energy Consumption</p> <p>Mod.3.6: Safety with Electricity</p>
	<p>Module 4: Invention Convention: The Student As Inventor</p> <p>Mod.4.1: Design Your Own Invention OR Build a Better...</p> <p>Mod.4.2: Design a Logo/Business Card</p> <p>Mod.4.3: Promotion</p> <p>Mod.4.4: Showtime</p> <p>Mod.4.5: Mission Accomplished: A Reflection</p>	

Summaries of Unit Components

Each component of the IMYM6 unit begins with a Summary that guides teachers in developing their own schedule for the instruction and assessment of each learning experience. The Summary table provides an estimated timeframe for and a brief explanation of the focus of each learning experience. The learning experiences within each of the OLEs, ICTs, and modules are numbered on the top right-hand corner of the pages on which they begin, in a manner reflecting the section (e.g., OLE.4: Reading Circles is the fourth learning experience in the OLE section and Mod.2.2: Biography of an Inventor or a Scientist is the second learning experience in Module 2).

Teachers should be aware that the *Inventions, Innovations, and Discoveries* unit serves only as a guide to interdisciplinary instruction to integrate ICTs at Grade 6. A variety of suggestions for instruction are provided, along with suggestions for variations and/or extensions to facilitate adaptations, in order to meet students' learning needs and to reflect the teachers' instructional approaches. The number of learning experiences in the unit may exceed the timeframe teachers allot for the unit; therefore, teachers may wish to be selective in choosing learning experiences. The learning experiences may be adapted and the order of instruction may be varied, unless otherwise specified. In that case, however, teachers need to reassess which specific learning outcomes students may achieve through the learning experiences.

Organization of Learning Experiences

The learning experiences within each component of the Grade 6 *Inventions, Innovations, and Discoveries* interdisciplinary unit follow a similar organization and contain the following components:

- Time (Suggested Time Allocation for the Learning Experience)
- Overview (of the Learning Experience)
- Learning Outcomes
- ICT Literacy Skills and Competencies
- Suggested Learning Resources
- Suggestions for Instruction
- Suggestions for Assessment
- Connection to Invention Convention

A detailed discussion of these components follows.

Time (Suggested Time Allocation for the Learning Experience)

The time specified for each learning experience or part of a learning experience within the *Inventions, Innovations, and Discoveries* interdisciplinary unit serves as a guide to learning experience and unit planning. Although the OLE and ICT components of the unit are intended to be taught over the entire school year, the unit modules themselves are taught throughout the school day for a period of approximately six to eight weeks. The modules may begin at the point when teachers choose to proceed with the interdisciplinary unit itself.

Overview (of the Learning Experience)

Each overview gives a brief synopsis of a given learning experience, describing its purpose and summarizing student learning tasks. When a learning experience is divided into parts, each part may have its own overview (e.g., Mod.1.3a: Back to the Future: A Timeline of Discoveries).

Learning Outcomes

Specific learning outcomes (SLOs) from the core subject areas of the Manitoba curriculum form the basis for the interdisciplinary approach of *Inventions, Innovations, and Discoveries*. Each

learning experience identifies the most applicable SLOs from the core subject areas (English language arts, mathematics, science, and social studies) that students may achieve through the suggestions for instruction and assessment. When adapting a learning experience, teachers need to review the list of SLOs provided and add to or delete from the list accordingly. The numbers and codes that accompany the SLOs cited in this unit correspond to the reference systems explained in the respective curriculum documents.

The Grade 6 subject-specific learning outcomes cited in *Inventions, Innovations, and Discoveries* are identified in the following Manitoba curriculum documents:

- *Grades 5 to 8 English Language Arts: Manitoba Curriculum Framework of Outcomes and Grade 6 Standards* (Manitoba Education and Training)
General Learning Outcomes (GLOs) 1 to 5 are addressed throughout the unit. Students will listen, speak, read, write, view, and represent to
 - GLO 1: explore thoughts, ideas, feelings, and experiences
 - GLO 2: comprehend and respond personally and critically to oral, literary, and media texts
 - GLO 3: manage ideas and information
 - GLO 4: enhance the clarity and artistry of communication
 - GLO 5: celebrate and build community
- *Grades 5 to 8 Mathematics: Manitoba Curriculum Framework of Outcomes and Grade 6 Standards* (Manitoba Education and Training)
 - Strand: Statistics and Probability; Sub-strand: Data Analysis
 - Strand: Number; Sub-strands: Number Concepts, Number Operations
- *Grades 5 to 8 Science: Manitoba Curriculum Framework of Outcomes* (Manitoba Education and Training)
 - Cluster 0: Overall Skills and Attitudes
 - Cluster 1: Diversity of Living Things
 - Cluster 3: Electricity
 - Cluster 4: Exploring the Solar System
- *Kindergarten to Grade 8 Social Studies: Manitoba Curriculum Framework of Outcomes* (Manitoba Education and Youth)
Grade 6: Canada: A Country of Change (1867 to Present)
 - GLO C: Citizenship
 - GLO I: Identity, Culture, and Community
 - GLO L: The Land: Places and People
 - GLO E: Economics and Resources

Refer to Appendix B: Grade 6 Curricular Outcomes and ICT Literacy Skills and Competencies for a list of SLOs from the Grade 6 English Language Arts, Mathematics, Science, and Social Studies curricula that students may achieve through this unit.

ICT Literacy Skills and Competencies

The ICT literacy skills and competencies that students may achieve in a given learning experience are also identified throughout *Inventions, Innovations, and Discoveries*. These ICT literacy skills and competencies are identified on the Information Technology Literacy Continuum in *Technology As a Foundation Skill Area* (Manitoba Education and Training 20-24). Specifically, they are cited on the continuum for the Skill Development Stage (Middle Years). The numbers and codes that accompany the specific literacy outcomes cited in this unit correspond to the reference system explained in the original document.

See Appendix B for a list of ICT literacy skills and competencies that students may achieve through *Inventions, Innovations, and Discoveries*.

Suggested Learning Resources

The learning resources suggested for the learning experiences are listed under the following categories:

- **Software**

The computer software and hardware referenced within the Grade 6 interdisciplinary unit is listed in Table 5,

Table 5: Hardware and Software for *Inventions, Innovations, and Discoveries*

Hardware	Software
<p>Hardware suggested to implement this unit:</p> <ul style="list-style-type: none"> • one multimedia laptop computer for the teacher • up to five networked classroom computers with Internet access • multimedia presentation device (such as a large-screen television, data projector, or electronic whiteboard) • printer • digital video camera or digital camera • CD burner • videocassette recorder (VCR) • telephone within the classroom <p>Note: Either Windows Operating System or Macintosh OS may be used.</p>	<p>Software suggested throughout this unit:</p> <ul style="list-style-type: none"> • concept mapping • database • electronic encyclopedias • email • graphics • Internet browsers • multimedia authoring • photo editing • spreadsheet • web page authoring • word processing

- **Internet**

For a regularly updated listing of websites related to *Inventions, Innovations, and Discoveries*, refer to the Interdisciplinary Middle Years Multimedia (IMYM) resources on the Department's IMYM Links Database at: <<http://www.edu.gov.mb.ca/ks4/tech/imym/resources/links.html>>.

Teachers can search lists of suggested websites appropriate for the Grade 6 *Inventions, Innovations, and Discoveries* interdisciplinary unit in the following ways:

- Selecting **General IMYM6** will provide a list of all websites referenced in the unit.
- Selecting a **Module** will provide a choice of
 - **General:** a list of all the websites within each module of the unit
 - **Learning Experience within the Module:** a list of all appropriate websites for each learning experience
- Selecting **OLE** or **ICT** will provide a choice of
 - **General:** a list of all the websites within each OLE or ICT learning experience
 - **Learning Experience within the OLEs or ICTs:** a list of all appropriate websites for each learning experience

- **Print, CD-ROMs, Videos, and Games**

A wide range of print, CD-ROM, and video resources are suggested within this unit to encourage a resource-based approach to learning (see Manitoba Education and Training, *Resource-Based Learning: An Educational Model*). The Selected Bibliography cites numerous titles intended to support the Grade 6 interdisciplinary unit, listed under the following headings/categories:

- Biographies
- Fiction
- Informational Resources
- Professional Resources
- Departmental Publications

Teachers can choose resources from the suggested list or they may find other suitable resources.

- **Blackline Masters (BLMs) and Teacher Blackline Masters (TBLMs)**

Many of the learning experiences in this unit include blackline masters (BLMs), which are intended for student use. Teachers may adapt and duplicate them as required. The BLMs may be downloaded from the Department's IMYM website at:

<<http://www.edu.gov.mb.ca/ks4/tech/imym/6/blms.html>>.

In addition to providing BLMs for students, this unit offers instructional and assessment supports in the form of teacher blackline masters (TBLMs), many of which may be adapted according to need. The TBLMs include guidelines for assignments, background information, forms, checklists, and rubrics. They relate directly to the instructional and/or assessment strategies suggested for a specific learning experience and are located within that learning experience. Some are referenced in other learning experiences where they may be useful for review or continued work.

The BLMs and TBLMs are numbered consecutively within each learning experience of the *Inventions, Innovations, and Discoveries* unit. The BLM and TBLM numbers identify the unit components in which they are located (i.e., OLE, ICT, or Mod.) and their sequence within the component (e.g., BLM OLE.3#2 is the second BLM in the third Ongoing Learning Experience; TBLM Mod.2.6#1 is the first TBLM in the sixth learning experience of Module 2).

- **Materials**

Resources that do not belong in the above categories are listed here. They include common classroom supplies, resources for experiments, charts, and so on.

Suggestions for Instruction

The instructional suggestions include the following components:

- **Preparation and Set-up**

Suggestions are provided to assist teachers in getting ready for a specific learning experience.

- **Activating, Acquiring, and Applying Strategies**

The instructional strategies suggested in each learning experience integrate two or more subject areas with various suggestions for integration of ICTs. Strategies are arranged into the three steps of active learning: Activating, Acquiring, and Applying (see Manitoba Education and Training, *Success for All Learners*).

- **Variations/Extensions**

Many learning experiences suggest exemplary instructional strategies for challenging students further.

The selection of appropriate strategies for instruction is left to teachers' discretion.

Suggestions for Assessment

To determine whether students have achieved specific learning outcomes, assessment must be an ongoing, integrated, and formative part of learning and teaching. In an article entitled "Seven Principles for Good Practice in Undergraduate Education" Chickering and Gamson state:

Knowing what you know and don't know focuses your learning. Students need appropriate feedback on performance to benefit from [their learning]. When getting started, students need help in assessing their existing knowledge and competence. [While acquiring new learning,] students need frequent opportunities to perform and receive suggestions for improvement. At various points during [an interdisciplinary unit,] and at the end, students need chances to reflect on what they have learned, what they still need to know, and how to assess themselves. (5)

In a later work entitled "Implementing the Seven Principles: Technology As Lever," a work that takes into consideration the integration of ICT, Chickering and Ehrmann expand:

As we move toward portfolio evaluation strategies, computers can provide rich storage and easy access to student products and performances. Computers can keep track of early efforts, so instructors and students can see the extent to which later efforts demonstrate gains in knowledge, competence, or other valued outcomes.

In this unit, suggestions for assessment are provided for each learning experience as a guide for measuring and monitoring student progress and achievement in relation to general and specific learning outcomes identified for Grade 6 students.

The suggestions for assessment range from the use of simple checklists, to journal responses, to complex rubrics. The suggested strategies take into consideration multiple intelligences and diverse learning and thinking approaches. Teachers are encouraged to make appropriate adjustments to the suggested assessment strategies based on individual students' learning needs, targeted student learning outcomes, and school reporting criteria. Students are encouraged to reflect upon their learning (metacognition) and to assess their own efforts and those of their peers.

Many assessment BLMs from the following departmental publications are identified for use throughout this unit:

- Manitoba Education and Training. *Grades 5 to 8 English Language Arts: A Foundation for Implementation*. Winnipeg, MB: Manitoba Education and Training, 1998.
- ---. *Success for All Learners: A Handbook on Differentiating Instruction*. Winnipeg, MB: Manitoba Education and Training, 1996.

For further suggestions, teachers may choose to consult the assessment section of both these documents, as well as other departmental resources (see Appendix C: Index of Teaching and Learning Strategies and Tools and the Departmental Publications section of the Selected Bibliography for this unit).

It is assumed that teachers will assess group behaviour and learning throughout this unit. Many observation checklists are provided in this unit. Teachers can find additional assessment suggestions and BLMs within other provincial curriculum and support documents.

For more information on assessment of a collaborative task, see "The Collaborative Classroom" (2Learn.ca Education Society).

Connection to Invention Convention

Each learning experience within Modules 1, 2, and 3 includes a description of how completing that learning experience leads to the final product in Module 4: Invention Convention: The Student As Inventor.

Appendices

Inventions, Innovations, and Discoveries contains the following appendices:

- **Appendix A: Essential Understandings and Guiding Questions**
Appendix A lists the essential understandings emerging from this Grade 6 interdisciplinary concept-based unit, and the guiding questions suggested for inquiry that promote higher-level thinking in students.
- **Appendix B: Grade 6 Curricular Outcomes and ICT Literacy Skills and Competencies**
Appendix B lists the Grade 6 English language arts, mathematics, science, and social studies learning outcomes, and the Middle Years ICT literacy skills and competencies that students may achieve through the learning experiences in the *Inventions, Innovations, and Discoveries* unit.
- **Appendix C: Index of Teaching and Learning Strategies and Tools**
Appendix C provides a selected list of instructional and assessment strategies and tools suitable for Grade 6 students, which can be found in the following provincial publications:
 - *Grades 5 to 8 English Language Arts: A Foundation for Implementation* (Manitoba Education and Training)
 - *Success for All Learners: A Handbook on Differentiating Instruction* (Manitoba Education and Training)
 Many of these strategies and tools are referred to in the *Inventions, Innovations, and Discoveries* interdisciplinary unit.
- **Appendix D: List of Blackline Masters (BLMs) and Teacher Blackline Masters (TBLMs)**
Appendix D lists the BLMs and TBLMs included in this unit. They are listed in the order in which they first appear within this unit, as well as by categories of purpose. Although the BLMs and TBLMs are specific to a learning experience, many can easily be adapted for use in other learning situations throughout the unit, as well as other areas of study.
- **Appendix E: Glossary of Acronyms, Terms, and Abbreviations**
Many acronyms and abbreviations are used throughout the *Inventions, Innovations, and Discoveries* interdisciplinary unit to facilitate the flow of reading. These are explained in Appendix E.

Selected Bibliography

The Selected Bibliography cites the references used in developing *Inventions, Innovations, and Discoveries*, as well as additional suggested print, videocassette, CD-ROM, and online resources that may be useful for teachers and students for this interdisciplinary unit. Some citations include brief annotations.

The selected resources are organized under the following headings/categories:

- Biographies
- Fiction
- Informational Resources (including Inventions, Electricity)
- Professional Resources
- Departmental Publications

Although the resources listed in the Selected Bibliography have not been reviewed, teachers can access most of the titles in the holdings of the Department's Instructional Resources Unit (IRU) Library (1181 Portage Ave., Winnipeg, MB) at: <<http://library.edu.gov.mb.ca:4100/>>. The videos listed in the Selected Bibliography are available either through IRU or, in the case of electricity-related videos, through Manitoba Hydro at: <<http://www.hydro.mb.ca/>>.

INSTRUCTIONAL MODEL

When implementing *Inventions, Innovations, and Discoveries*, teachers need to consider a wide range of instructional issues, such as the following.

IMYM Model

The Interdisciplinary Middle Years Multimedia (IMYM) model demonstrates how the integration of ICTs with best instructional practice can add value to learning, teaching, and assessment. It promotes a professional learning and support strategy for Middle Years teachers and teacher mentors that has resulted in a paradigm shift for educators as they restructure their classrooms to use technology to support collaborative learning.

For a series of Professional Learning Experiences designed to help teachers implement the IMYM model in their classrooms, refer to Characteristics of the IMYM Classroom on the Department's IMYM website at:

<<http://www.edu.gov.mb.ca/ks4/tech/imym/workshops/lrngctr/index.html>>.

Interdisciplinary Instruction

Interdisciplinary instruction, incorporating each of the foundation skills, the elements of integration, and the ICTs, takes place most readily in a school and classroom framework that follows the Middle Years model of one teacher in a classroom. Flexible timetables with longer undifferentiated blocks of time and fewer contact teachers will facilitate teaching the *Inventions, Innovations, and Discoveries* interdisciplinary unit.

Middle Years Model

The Implementation Overview of *Grades 5 to 8 English Language Arts: A Foundation for Implementation* states:

Grades 5 to 8 students are typically between 10 and 14 years of age. Literacy learning in the Middle Years requires a unique classroom culture and climate that is different from that required for Early Years or Senior Years students. Middle Years students are distinguished by special intellectual, moral, physical, emotional/psychological, and social characteristics that shape the way they learn. The methods, contexts, resources, and supports that Middle Years teachers choose are determined by the needs of students, and so Middle Years teachers' instructional styles, attitudes, and pacing will be different from those of Early Years or Senior Years educators.

Teachers and students bring a range of abilities to the classroom. The National Middle School Association has documented some of the personal and professional traits that characterize Middle Years students and teachers. (Manitoba Education and Training, Overview-4).

The traits of Middle Years students can be read on the English Language Arts section of the Department's website at: <<http://www.edu.gov.mb.ca/ks4/cur/ela/docs/middleyears.html>>.

Constructivist Learning

Within the constructivist classroom, teachers have unique responsibilities:

A constructivist teacher and a constructivist classroom exhibit a number of discernable qualities markedly different from a traditional or direct instruction classroom. A constructivist teacher is able to flexibly and creatively incorporate ongoing experiences in the classroom into the negotiation and construction of lessons with small groups and individuals. The

environment is democratic, the activities are interactive and student centered, and the students are empowered by a teacher who operates as a facilitator/consultant. (Gray)

The constructivist approach to learning is central to the *Inventions, Innovations, and Discoveries* unit. In IMYM Project evaluations, pilot teachers report that following the IMYM training, their teaching has changed from a traditional transmissive model to a constructivist model, and their classrooms tend to be set up to allow for a student-centred approach to learning. (See IMYM website at: <<http://www.edu.gov.mb.ca/ks4/tech/imym/results/index.html#ProjectEvaluations>>.) Table 6 gives an overview of both models.

Table 6: Transmissive and Constructivist Models

Transmissive Model	Constructivist Model
The transmissive model is characterized by <ul style="list-style-type: none"> • coverage of a vast curriculum of isolated facts and skills 	The constructivist model is characterized by <ul style="list-style-type: none"> • brainstorming to activate prior knowledge
<ul style="list-style-type: none"> • direct teaching to the students 	<ul style="list-style-type: none"> • acquisition of new learning, skills, and competencies, and development of meaningful links between each
<ul style="list-style-type: none"> • frequent written homework 	<ul style="list-style-type: none"> • application of new ways of thinking in authentic contexts
<ul style="list-style-type: none"> • assessment with written tests 	<ul style="list-style-type: none"> • assessment and authentic communication of new abilities

The basic premise of the constructivist model is that learners construct knowledge:

Constructivism is an approach to teaching and learning based on the premise that cognition (learning) is the result of “mental construction.” In other words, students learn by fitting new information together with what they already know. Constructivists believe that learning is affected by the context in which an idea is taught as well as by students' beliefs and attitudes. (North Central Regional Educational Laboratory)

Students need opportunities to think about their learning in order to construct meaning. The IMYM model allows for this to happen by providing a classroom environment that facilitates opportunities for group collaboration, discussions, and sharing of learning. The instructional model being employed by this project shifts the role of the teacher from disseminator of information to facilitator of active learning. Teachers use a variety of instructional strategies. For example, they may use a multimedia computer and projection equipment for large-group instruction. Alternatively, students work in collaborative groups at multimedia workstations, lab stations, or other learning experience centres around the classroom.

The instructional model used in this project was based on research that has been summarized in *Curricular Connections* (Manitoba Education and Training).

Collaborative Learning

Collaborative learning is a vital part of this unit:

Effective communication and collaboration are essential to becoming a successful learner. It is primarily through dialogue and examining different perspectives that students become knowledgeable, strategic, self-determined, and empathetic. Moreover, involving students in real-world tasks and linking new information to prior

knowledge requires effective communication and collaboration among teachers, students, and others. Indeed, it is through dialogue and interaction that curriculum outcomes come alive. Collaborative learning affords students enormous advantages not available from more traditional instruction because a group—whether it be the whole class or a learning group within the class—can accomplish meaningful learning and solve problems better than any individual can alone. (Manitoba Education, Citizenship and Youth, IMYM Research Results, <<http://www.edu.gov.mb.ca/ks4/tech/imym/results/links.html>>)

Information about collaborative learning can be found in the following resources:

- Manitoba Education and Training. *Grades 5 to 8 English Language Arts: A Foundation for Implementation*. Winnipeg, MB: Manitoba Education and Training, 1998. (See Strategies That Make a Difference.)
- ---. *Success for All Learners: A Handbook on Differentiating Instruction*. Winnipeg, MB: Manitoba Education and Training, 1996. (See Chapter 5: Flexible Grouping.)
- Tinzmann, M.B., B.F. Jones, T.F. Fennimore, J. Bakker, C. Fine, and J. Pierce. *What Is the Collaborative Classroom?* Oak Brook, IL: North Central Regional Educational Laboratory (NCREL), 1990. Available on the NCREL website at: <http://www.ncrel.org/sdrs/areas/rpl_esys/collab.htm>.

Curriculum Integration

This interdisciplinary unit integrates the use of ICTs and learning outcomes from the four core subject areas: English language arts, mathematics, science, and social studies.

More information on integrating various subject areas using a theme-based or concept-based approach can be found in the following resources:

- Cruz, Bárbara C. "Global Education in the Middle School Curriculum: An Interdisciplinary Perspective." *Middle School Journal* 30.2 (Nov. 1998): 26-31.
- Erickson, H. Lynn. *Planning Integrated Units: A Concept-Based Approach*. Videocassette. Alexandria, VA: Association for Supervision and Curriculum Development, 1997.
- Manitoba Education and Training. *Curricular Connections: Elements of Integration in the Classroom*. Winnipeg, MB: Manitoba Education and Training, 1997.
- Tomlinson, Carol Ann. "For Integration and Differentiation Choose Concepts over Topics." *Middle School Journal* 30.2 (Nov. 1998): 3-8.

Inquiry Process

Through the inquiry process, students engaged in the *Inventions, Innovations, and Discoveries* unit are encouraged to take ownership of their learning. TBLM ICT.10#1: Questioning offers many suggestions and references on the subject.

More information on questioning strategies can be found in the following resources:

- Galas, Cathleen. "The Never-Ending Story: Questioning Strategies for the Information Age." *Learning and Leading with Technology* 26.7 (April 1999): 10-13.
- Harvey, Stephanie. *Nonfiction Matters: Reading, Writing, and Research in Grades 3-8*. York, ME: Stenhouse, 1998.

Classroom Set-up

For a discussion of a variety of classroom set-ups for instruction in whole-group, small-group, or individual settings and for suggested strategies that work well in each situation, see Chapter 5:

Flexible Grouping in *Success for All Learners* (Manitoba Education and Training). Learning centres are a cornerstone of the *Inventions, Innovations, and Discoveries* interdisciplinary unit.

Homework

Students and parents should be reassured that homework will be provided throughout the *Inventions, Innovations, and Discoveries* unit. Teachers can assign some BLMs and independent research for student homework that does not necessarily require the use of technology. Teachers can also list homework and assignments on the classroom website.

ETHICAL AND PERSONAL CONSIDERATIONS

Teachers implementing the *Inventions, Innovations, and Discoveries* interdisciplinary unit need to be aware of many legal and personal issues related to copyright, plagiarism, privacy, and Internet safety (see ICT.9, ICT.10, and ICT.11).

Copyright

It is important to keep copyright issues in mind throughout this unit, as students use information and images from the Internet and other electronic sources, as well as from print sources. Proper permission and acknowledgement must be obtained as necessary. (See TBLM ICT.9#2: Acceptable Use of Copyrighted Electronic Resources). For detailed information on Canadian copyright laws and regulations, refer to the Department's Instructional Resources Unit (IRU) website at: <<http://www.edu.gov.mb.ca/ks4/iru/copyright/index.html>>.

The BLMs included within the *Inventions, Innovations, and Discoveries* unit either have been created by the IMYM6 development team or have had copyright clearance. All may be freely copied and adapted as necessary by including a reference to the original source.

Plagiarism

The issue of plagiarism becomes especially important as students begin using the Internet and other electronic sources, as information can easily be copied and pasted into an electronic file. See also TBLM ICT.9#1: "Internet 101" for Teachers.

Internet Safety

Student safety is an issue whenever students have Internet access. As identified on the Information Technology Literacy Continuum in *Technology As a Foundation Skill Area*, students will "explore the use of information technology in an appropriate, safe, and responsible manner" (Manitoba Education and Training 24).

Most school divisions have developed an Acceptable Use Policy that outlines for students and parents the types of student behaviours that are acceptable and behaviours that are not acceptable when using information technology resources. Nevertheless, teachers need to monitor students' Internet use, and monitor any email contacts that students make.

Privacy

As students begin to email information to other sites or to publish on the Internet, it is important to keep in mind the school division's Acceptable Use Policy regarding the publication of pictures, text, and names of students. Teachers need to be aware of any students in the class for whom privacy issues are of special concern. Such students may need alternative assignments if they are unable to publish any information about themselves.