Senior Years Industrial Arts

Manitoba Curriculum Framework of Outcomes

Manitoba

Senior Years
Industrial Arts

Manitoba Curriculum Framework of Outcomes

2009
Manitoba Education, Citizenship and Youth

Manitoba Education, Citizenship and Youth Cataloguing in Publication Data

607.12712 Senior years industrial arts: Manitoba curriculum framework of outcomes

ISBN-13: 978-0-7711-3676-4

1. Industrial arts—Study and teaching (Secondary)—Manitoba. 2. Industrial arts—Curricula. I. Manitoba. Manitoba Education, Citizenship and Youth.

Copyright © 2009, the Government of Manitoba as represented by the Minister of Education, Citizenship and Youth.

Manitoba Education, Citizenship and Youth
School Programs Division
Winnipeg, Manitoba, Canada

Every effort has been made to acknowledge original sources and to comply with copyright law. If cases are identified where this has not been done, please notify Manitoba Education, Citizenship and Youth. Errors or omissions will be corrected in a future edition. Sincere thanks to the authors and publishers who allowed their original material to be used.

All images found in this document are copyright protected and should not be extracted, accessed, or reproduced for any purpose other than for their intended educational use in this document.

Print copies of this resource can be purchased from the Manitoba Text Book Bureau (stock number 80444). Order online at <www.mtbb.mb.ca>.

This resource is also available on the Manitoba Education, Citizenship and Youth website at <www.edu.gov.mb.ca/k12/cur/teched/ind_arts.html>.

Websites are subject to change without notice.

Acknowledgements

Manitoba Education, Citizenship and Youth gratefully acknowledges the contributions of the following individuals in the development of *Senior Years Industrial Arts: Manitoba Curriculum Framework of Outcomes.*

Principal Writer	Dennis Wasylyniuk	
Committee Members	Larry Argue	Oak Park High School Pembina Trails School Division
	Brad Badiuk	Kelvin High School Winnipeg School Division
	Doug Cameron	Glenlawn Collegiate Louis Riel School Division
	Lee Cole	Carman Collegiate Prairie Rose School Division
	Ralph Masi	Murdoch Mackay River East — Transcona School Division
	Kurt Proctor	Industrial Arts Teacher Education Red River College
	Carl Sauerborn	Gimli High School Evergreen School Division
	Brian Weiser	Westwood Collegiate St. James-Assiniboia School Division

Continued

Manitoba Education, Citizenship and Youth Staff

Louise Boissonneault Publications Editor (after August 2005)	Document Production Services Unit Educational Resources Branch
Lee-Ila Bothe Coordinator	Document Production Services Unit Educational Resources Branch
Diane Cooley Project Manager (until April 2007)	Curriculum Unit Instruction, Curriculum and Assessment Branch
Peter Fuller Consultant	Program and Policy Services Unit Instruction, Curriculum and Assessment Branch
Darryl Gervais Project Manager (after February 2008)	Development Unit Instruction, Curriculum and Assessment Branch
Aileen Najduch Project Manager (April 2007 to February 2008)	Development Unit Instruction, Curriculum and Assessment Branch
Ken Nimchuk Project Leader	Learning Support and Technologies Unit Instruction, Curriculum and Assessment Branch
Jan Oakley Publications Editor (until July 2005)	Production Support Unit Instruction, Curriculum and Assessment Branch
Lindsay Walker Desktop Publisher	Document Production Services Unit Educational Resources Branch

CONTENTS

Acknowledgements iii

Introduction 1
- Background 1
- Vision 2

Overview of Senior Years Industrial Arts Framework 5
- Framework Rationale 5
- Industrial Arts Strands 6
- Instructional Philosophy 6
- Implementation Techniques 8
- Instructional Approaches and Assessment 8
- Glossary of Instructional Approaches 10
- Learning Outcomes Structure 13

Senior Years General Learning Outcomes 15
- General Learning Outcomes 17
- Fundamental Skills 18
- Personal Skills 18
- Production Skills 19

Senior Years Specific Learning Outcomes 23
- A Guide to Reading Learning Outcome Numbering 25

Senior Years Drafting Design Technology 27
- Fundamental Skills 29
- Personal Skills 32
- Production Skills 38

Senior Years Electricity/Electronics Technology 47
- Fundamental Skills 49
- Personal Skills 52
- Production Skills 58

Senior Years Graphic Communication Technology 65
- Fundamental Skills 67
- Personal Skills 70
- Production Skills 76

Senior Years Metalwork Technology 83
- Fundamental Skills 85
- Personal Skills 88
- Production Skills 94

Senior Years Power Mechanics Technology 101

Fundamental Skills 103

Personal Skills 106

Production Skills 112

Senior Years Woodwork Technology 121

Fundamental Skills 123

Personal Skills 126

Production Skills 132

Appendices 139

Appendix A: Writing Learning Outcomes 141

Appendix B: A Design/Problem-Solving Process 145

References 147

INTRODUCTION

Background

Industrial Arts Rationale

Industrial Arts education provides lifelong learning patterns for living and working effectively in a changing technological environment. Participants in Industrial Arts programming work actively in a hands-on environment with technological tools, materials, and processes to transform concepts and ideas into goods and services. Problems, ideas, and concepts are explored from the research/investigation stage to product construction, and ultimately to final testing and assessment/evaluation of the goods produced. Because of the changing nature of society and the workplace, the practical skills and knowledge developed in Industrial Arts education are relevant to many other areas of life.

Education needs to be about developing foundation skills. Industrial Arts provides students the opportunity to work independently and co-operatively as they apply decision-making, problem-solving, and critical-thinking skills to problems and/or issues. Additional skills such as inferring, synthesizing, analyzing, and evaluating, as well as a complete range of communication skills including listening, speaking, representing, viewing, reading, and writing are part of Industrial Arts classrooms. These learning environments offer challenging, stimulating, and enjoyable activities that motivate people.

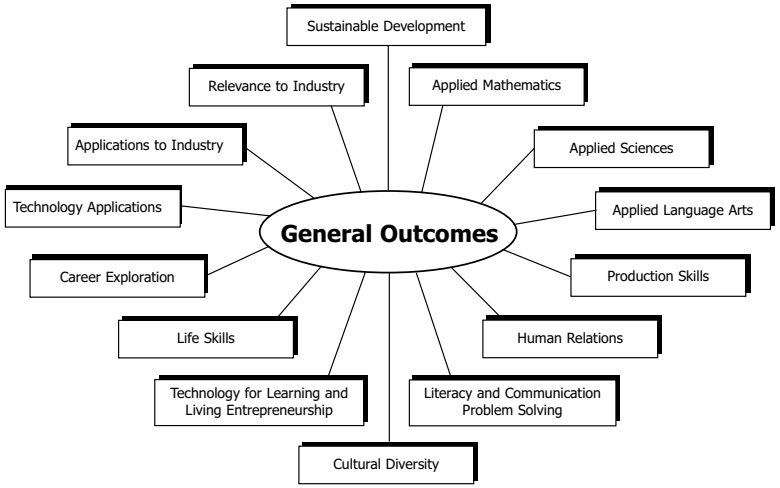
Curricular Foundations

This document represents the first major Senior Years Industrial Arts curriculum review since the mid-1980s. That review resulted in the development of eighteen Grade 10 to Grade 12 Industrial Arts courses (Drafting 101, 201, 301; Electricity/Electronics 101, 201, 301; Graphics 101, 201, 301; Metalwork 101, 201, 301; Power Mechanics 101, 201, 301; and Woodwork 101, 201, 301). The framework serves as a basis for the development of Grade 9 to Grade 12 Industrial Arts courses. It replaces the former curriculum documents mentioned above.

The need to make curricula more responsive to the needs of the students and the community has resulted in significant changes. The emphasis in Industrial Arts courses on problem-solving, teamwork skills, creative design, and diverse learning styles is reflected in the new framework. The shift from previous curricula structures to the new framework involves the following major changes:

Former Guidelines	New Frameworks
1. Goals and objectives	1. Student Learning Outcomes
2. Focus on teacher inputs	2. Focus on how students learn, and on integrated components to learning
3. Teaching concepts separately	3. Themes and concepts
4. Layers of learning	4. Spirals of learning
5. Linear, lock-step sequential outline of content	5. Thinking and problem-solving skills
6. Passive participation	6. Active participation

Industrial Arts programming teaches students to apply knowledge and skills from other subject areas as they learn new skills to analyze problems, design solutions, and create products.



This document builds on recent education research, including

- the restructuring of educational objectives as General Learning Outcomes and Specific Learning Outcomes
- brain-based research which has led to theory on multiple intelligences, learning styles, and thinking styles
- authentic assessment
- school-to-work transition skills

Vision

Learning Environment

Industrial Arts students are immersed in a holistic learning environment that prepares them to adapt to a society in which the workplace is rapidly changing with advancing technology and blurred career lines.

Industrial Arts students gain a unique, meaningful, and practical experience while learning in a facility that relates to out-of-school experiences. They gain a variety of life and employability skills while working with hands-on applications.

Lifelong Skills

The Industrial Arts experience and environment leads to the development of life and employability skills. Students gain technological literacy and an array of life skills. They learn to

- manipulate materials and tools
- interact with processes
- define, analyze, and solve problems
- design and create products
- apply and integrate knowledge
- work safely
- manage time
- manage information
- work on teams

- communicate
- observe and record data
- show initiative
- be responsible
- be adaptable

Integration of Experience

Industrial Arts facilities provide the venue for the integration of learning experiences for students. Students gain a new depth of understanding because of the integration of knowledge and skills in a practical setting. Industrial Arts courses integrate a blend of knowledge in the physical and biological sciences, social sciences, and the arts and humanities, with activities that incorporate the four modalities of learning (kinesthetic, tactile, visual, and auditory).

This integration can occur naturally for the learner, or it may happen through a teacher-directed connection with other subject areas—a process which the Industrial Arts learning environment innately encourages. This serves to add relevance to the student's overall learning experience.

Active Learner

A student of Industrial Arts is an active learner in an activity-based course that demands thinking and doing. The student will

- take an active role in negotiating and planning specific activities to fulfill the learning outcomes
- participate in activities from design and development, through production and evaluations of activities
- practise and execute the necessary skills in applying production skills
- use combinations of intellectual, physical, and multiple sensory skills
- participate as a member of a team
- transfer and adapt previous learned knowledge, skills, and attitude

Teacher's Role

The teacher's role is to

- be a facilitator and a co-learner
- act as a role model
- plan and manage themes and concepts
- provide opportunities for students to develop skills and knowledge
- be prepared to venture with students into unpredictable situations where, together, solutions to technological problems will be pursued

Senior Years Industrial Arts Framework Purpose

In Manitoba, Industrial Arts programming represents a wide variety of learning opportunities that focus on fundamental personal and production skill development. This framework strives to affirm and strengthen current practices while encouraging teachers to broaden the focus of their courses.

This framework will serve to

- enhance and reaffirm the value of Industrial Arts courses
- provide a framework for the development of further support documents for Industrial Arts
- guide teachers in enhancing current practices
- strengthen and revitalize programming
- provide General Learning Outcomes that introduce two new skill sets for all Industrial Arts courses
- provide Specific Learning Outcomes that are common to all Senior Years Industrial Arts strands

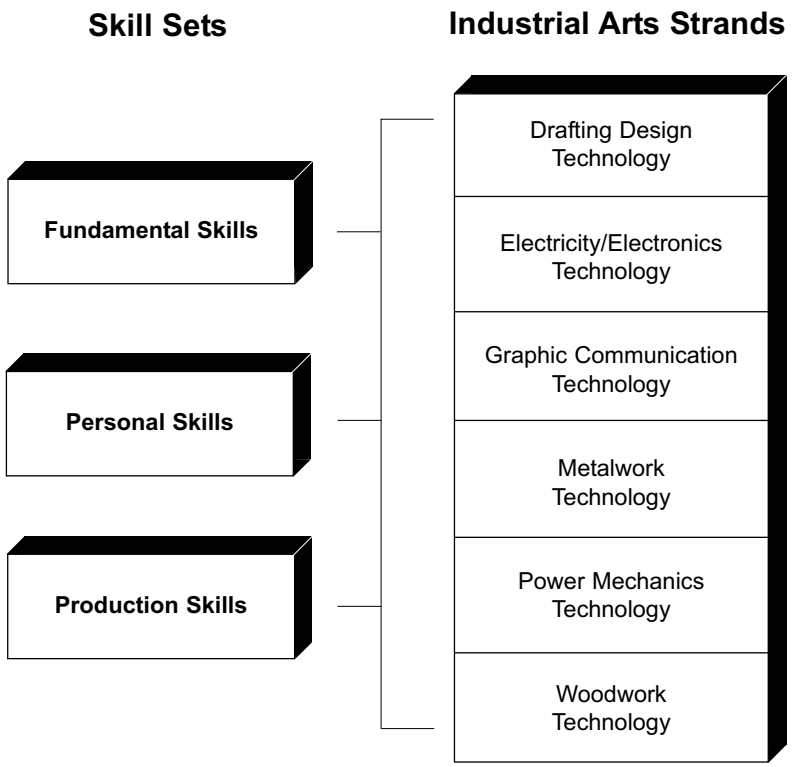
Framework Rationale

This framework has been designed to provide students with the opportunity to develop transferable learning skills. These learning skills are grouped into three sets:

- **Fundamental Skills**—the basic skills for study in Industrial Arts
- **Personal Skills**—the basic skills for personal effectiveness and growth
- **Production Skills**—the basic skills for production and fabrication

These skill sets are reflected in work done by The Conference Board of Canada (*Employability Skills 2000+*), Human Resources Development Canada (*Essential Skills Research Project*), and The National Life/Work Centre (*The Blueprint for Life/Work Designs*).

The framework is designed to support and broaden the focus of Industrial Arts. It is intended to be used by teachers to strengthen and revitalize programming. The General Learning Outcomes are interrelated and interdependent. Each outcome is to be achieved through a variety of learning strategies and experiences.



Three skill sets apply to each Industrial Arts strand.

Industrial Arts Strands

Industrial Arts is available in a variety of strands based on facility configurations. The following chart outlines Industrial Arts strands for Middle Years and Senior Years students.

Middle Years	Senior Years
Titles	Titles
Manufacturing ■ Metalwork ■ Plastics ■ Woodworking	**Drafting Design** ■ Drafting Design Technology
Graphic Communications ■ Drafting ■ Graphic Arts ■ Graphic Communications	**Electricity/Electronics** ■ Electricity/Electronics Technology
Power and Energy ■ Electricity/Electronics ■ Power Mechanics ■ Power/Energy	**Graphic Communication** ■ Graphic Communication Technology
Construction	**Metalwork** ■ Metalwork Technology
	Power Mechanics ■ Power Mechanics Technology
	Woodwork ■ Woodwork Technology ■ Construction Technology ■ Furniture Design Technology ■ Manufacturing Technology
	Applied Technology 40S

Instructional Philosophy

Industrial Arts teachers use various approaches to guide student learning. It is essential to recognize and utilize student learning styles, thinking styles, and capabilities. The following text summarizes three models that describe student differences in these areas.

Learning Styles

The model developed by Ken Dunn and Rita Dunn of St. John's University, New York, classifies students according to their learning styles:

- **Auditory learners** absorb spoken material easily and are likely to ask for information rather than read printed instructions.
- **Visual learners** learn best from information that they read or see.
- **Tactile learners** learn best by handling materials, writing, drawing, and being involved in concrete experiences.
- **Kinesthetic learners** learn best by moving and doing, by taking part in activities that have direct relevance to their lives.

Dunn and Dunn believe that most people have two highly developed learning styles, and that within a class of 30 students, 22 will be fairly balanced in their ability to take in information in a variety of ways.

Thinking Styles

Anthony Gregorc (1982) of the University of Connecticut has developed a theory of thinking styles based on two variables: the way we view the world (concretely or abstractly) and the way we order the world (in sequential order or random order). In Gregorc's framework, these two variables combine to describe four thinking styles:

- **Concrete sequential thinkers** are based in the physical world that they can detect through their senses. They notice and recall details easily, and remember facts, formulas, and rules with ease. They learn well through "hands-on" experiences.
- **Concrete random thinkers** are experimenters/ divergent thinkers, willing to take the intuitive leaps necessary for creative thought. They have a strong need to find alternatives and to do things in their own way.
- **Abstract sequential thinkers** love the world of theory and abstract thought. Their thinking processes are logical, rational, and intellectual. They prefer to work alone rather than in groups.
- **Abstract random thinkers** organize information through reflection, and thrive in unstructured, people-oriented environments. They live in the world of feelings and emotions, and learn best when information is personalized.

Multiple Intelligences

The theory of multiple intelligences is a cognitive model developed by Harvard psychologist Howard Gardner. Gardner's theory is that each of the following seven intelligences has an evolutionary history, its own symbolic system, and a separate locus in the human brain:

- **Verbal/linguistic intelligence** is responsible for the production of language and all of the complex possibilities that follow: storytelling, abstract reasoning, symbolic thinking, conceptual patterning, and, of course, the written word.
- **Logical/mathematical intelligence** is most often associated with "scientific thinking," deductive reasoning, and problem solving. This intelligence involves the capacity to recognize patterns, to work with abstract symbols such as numbers and geometric shapes, and to see connections between separate pieces of information.
- **Visual/spatial intelligence** deals with the visual arts, navigation and map-making, architecture, and games such as chess. The key sensory base of this intelligence is sight, but also the ability to form mental images.
- **Body/kinesthetic intelligence** is the ability to use the body to express emotion (as in dance and body language), to play a game, or to devise an invention. Individuals with high body/kinesthetic intelligence thrive on hands-on experience; they "learn to do by doing."

Multiple Intelligences: From *Seven Ways of Knowing: Teaching for Multiple Intelligences,* Second Edition, by David Lazear. © 1991 IRI/SkyLight Training and Publishing. Reprinted by permission of SkyLight Professional Development, <www.skylightedu.com> or 1-800-348-4474.

- **Musical/rhythmic intelligence** includes such capacities as the recognition and use of rhythmic and tonal patterns, and sensitivity to sounds from the environment, the human voice, and musical instruments. Many children learn the alphabet through this intelligence.
- **Interpersonal intelligence** involves the ability to communicate verbally and non-verbally, to work co-operatively in a group, and to observe the moods, temperament, and intentions of others. Individuals with high interpersonal intelligence are able to imagine and empathize with the experience of others.
- **Intrapersonal intelligence** involves knowledge of the self—of feelings, thinking processes, and spiritual realities. This intelligence involves our capacities for self-reflection, to experience wholeness and unity, to perceive higher states of consciousness, and to dream of and actualize the possible.

Gardner's multiple intelligences theory proposes that each person has capabilities of varying degree in all seven intelligences, and that we perform most functions through a complex interaction of several intelligences.

Implementation Techniques

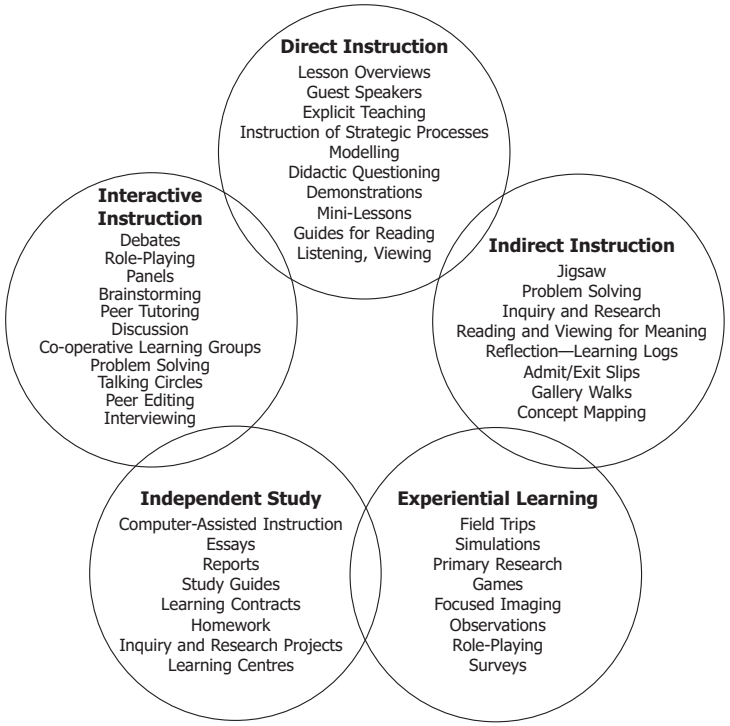
The learning styles previously described can be accommodated through a number of instructional focuses in an Industrial Arts facility. Some common techniques are

- **tools and materials focus**—focusing on the equipment and supplies used
- **process focus**—emphasizing the systematic use of materials
- **design/problem-solving focus**—developing the creative problem-solving and decision-making processes in a generic sense
- **project or product focus**—focusing on the net result of the skills developed

Instructional Approaches and Assessment

The General Learning Outcomes for Industrial Arts courses promote skill development and reflective learning. As there is no single way to teach or learn, teachers will organize their courses using one or a combination of the previously mentioned implementation techniques and then, while taking into account their students' learning and thinking styles, will use their professional judgment to decide which instructional approach will be most effective in promoting the learning of knowledge and skills. The "Instructional Approaches" diagram displays instructional approaches and methods of application.

Instructional Approaches



Students learn most effectively when their studies are rooted in concrete learning experiences, related to a particular context or situation, and applied to their world where appropriate. Ideas and understandings that students develop should be progressively extended and reconstructed as students grow in their experiences and their ability to conceptualize. Learning involves the process of linking newly constructed understandings with prior knowledge, and adding new contexts and experiences to current understandings.

To achieve the vision of Industrial Arts education, students must increasingly become engaged in the planning, development, and assessment of their own learning experiences. They should have the opportunity to work co-operatively with other students, to initiate investigations, to communicate their findings, and to complete projects that demonstrate their learning.

To assist teachers in their planning for instruction, assessment, evaluation, and reporting, Manitoba Education, Citizenship and Youth recommends that at the beginning of a block of instruction, teachers and students identify expected student learning outcomes and establish performance criteria. It is important that these criteria correspond with the student learning outcomes. This communication between students and teachers helps to identify clearly what needs to be accomplished, thereby assisting the learning process.

Instructional Approaches: Figure adapted, with permission, from Saskatchewan Education. *Instructional Approaches: A Framework for Professional Practice.* Copyright © 1991 by Saskatchewan Education.

When students are aware of expected learning outcomes, they will be more focused on the learning and more likely to assess their own progress. Furthermore, they can participate in creating appropriate assessment and evaluation criteria. Teachers are encouraged to use a variety of learning experiences and assessment and evaluation methods and tools that are valid, reliable, and fair to students. Consideration needs to be given to the many ways students learn, their diverse backgrounds and needs, as well as maximizing active learning time, and making learning meaningful.

Glossary of Instructional Approaches

Direct Instruction

Lesson Overviews—Teachers construct the frame that best suits their subject matter, grade, and classroom and lesson organization. Overviews are often put on a transparency or erasable poster so they can be reused with each class. The purpose is to help students focus on the goals of the lesson and to place the lesson in the context of a unit.

Guest Speakers—Inviting professionals or those with information on topics being studied offers students the opportunity to examine topics from a personal point of view and to obtain current, reality-based responses to questions.

Explicit Teaching—Teacher-directed lectures can provide students with information that may be required before high-order thinking can occur. Teachers are encouraged to provide information which meets at least two learning modalities (visual, auditory, tactile, and kinesthetic) by using visuals, writing on the board, and supplying handouts and reading notes.

Instruction of Strategic Processes—Strategic processes outline the steps required to complete a task and move on to the next level.

Modelling (role-playing, think alouds, and demonstrations)—Teachers model their use of strategies so that students can emulate them. Teachers verbalize all thoughts for students as they demonstrate skills or processes. After several modeling experiences, students should practise using the strategy in pairs. Ultimately, students should work independently with the strategy.

Didactic Questioning—By asking leading questions, teachers can draw information and answers from students.

Demonstrations—A teacher, student, or guest demonstrates a technique to students. This technique works best if students are allowed to practise the technique on their own or in pairs following the demonstration. The teacher or fellow students offer feedback. Students should be given the opportunity to reflect on their proficiency and areas for improvement.

Mini-Lessons—Mini-lessons are lessons that are 20 minutes in length. Recent brain research indicates that learning/retention occurs in the first 20 minutes of each class.

Guides for Reading, Listening, Viewing—Providing students with guides (e.g., guided notes for a video) helps them to identify important information and encourages attentiveness.

Indirect Instruction

Jigsaw—Individuals or small groups each explore a different topic or a different area of the same topic. Individuals or groups are then responsible for teaching their newly acquired knowledge to the rest of the class.

Problem Solving—Teachers can stimulate student thinking by presenting a situation in which the student works through a process which leads to a solution.

Inquiry and Research—Individually, in pairs, or in small groups, students explore topics and present their findings to the class via an oral presentation or Gallery Walk.

Reading and Viewing for Meaning—These are techniques of reading print material and viewing visual media to become more conscious, discerning, critical, and appreciative of the texts.

Reflection—Learning Logs: Students regularly write short, spontaneous, exploratory, personal pieces of writing about the content they are studying. It is writing for thinking and not for creating a polished product.

Admit/Exit Slips—Students fill in these small slips at the beginning and end of the class. They help students to focus on what they expect to learn, and to reflect on what they have learned. This provides the teacher with information on student learning.

Gallery Walks—Teachers or students display information and samples on various topics throughout the room. Individually, in groups, or as a class, students circulate and are presented different information at each station.

Concept Mapping—Teachers assign students a word or idea and have them generate related words and/or topics. Students then examine the relationships between the words and ideas they have generated.

Experiential Learning

Field Trips—Students visit sites that relate to topics being studied. The most successful excursions outside the classroom are those that are organized because students have asked to visit a particular site to further some aspect of research they have undertaken.

Simulations—Students practise a skill or technique under controlled or ideal conditions with teacher or peer guidance before they are given the opportunity to perform on their own.

Primary Research—Primary research explores original (first-hand) sources. It may include interviews or reading first-hand accounts of a person's experience or findings.

Games—Teachers conduct activities based on popular board or television games. Questions can be based on course content and can be written by the teacher or the students. Games can be used to review information or to activate learning prior to starting a unit.

Focused Imaging—Teachers talk students through an event. Students may choose to close their eyes, listen, and visualize as the teacher describes a process, event, or location. Focused imaging can be enhanced with sound effects.

Observations—Students and the teacher identify phenomena they are looking for and observe the frequency of occurrence. Observations can be used to determine how a process takes place. It is important that teachers remind students to remain objective (record what they see) and to not make assumptions regarding causes of phenomena.

Role-Playing—The teacher provides, or the students write skits which students act out in an effort to explain or demonstrate an idea or the sequence of a process.

Surveys—Students or the teacher develop questions and determine an audience in an effort to study a phenomenon, belief, or the perceptions of others.

Independent Study

Computer-Assisted Instruction (CAI)—Software (computer programs) can provide exercises for drill and practise, rapid evaluation of student response, student feedback, concrete representations of abstract concepts, and more one-on-one instructional time.

Essays and Reports—Students research and write on a topic assigned by the teacher, or one that they have chosen themselves.

Study Guides—Students review content through the use of a document that provides the framework of knowledge covered in a unit or course.

Learning Contracts—The teacher and students create a contract or proposal specifying the topic, learning outcomes, experiences, products, resources, timelines, and assessment.

Homework, Inquiry, and Research Projects—Students are given the opportunity to independently research and examine information.

Learning Centres—Teachers organize the classroom into various activity or learning stations. These offer opportunities for independent inquiry and exposure to a wide variety of materials and sources of information.

Interactive Instruction

Debates—The class is divided into two groups (teams). Each team is assigned one side of an issue to defend or promote. Teams are responsible for generating support for their side of the issue. Following the time assigned for developing arguments, students individually argue points on behalf of their team by introducing new points or offering a rebuttal to points made by the other team.

Role-Playing—The teacher provides or the students write skits which students act out in an effort to explain or demonstrate an idea or sequence of a process.

Panels—Panels are groups of people with first-hand knowledge or experience on a topic.

Brainstorming—Students generate ideas and information as a result of contributing what they already know, and building on the ideas of others.

Peer Tutoring—Students teach and learn from one another as they share their work.

Discussion—Discussion is the most useful way of transmitting information, learning what students think and know, and building a sense of classroom identity, when all class members have a chance to speak before anyone responds twice.

Co-operative Learning Groups—Students are placed into small groups or teams, based on the teacher's criteria, and work together at various times to achieve common learning goals.

Problem Solving—Problem solving is a meaningful task that centres on overcoming constraints or limiting conditions.

Talking Circles—Based on First Nations teachings, talking circles create a safe environment for discussion of conflicts, difficult situations, or decisions that students may face. This allows every student to be heard and teaches students to respect each other and build consensus.

Peer Editing—Peer editing can involve ongoing groups in which students give feedback on drafts of each other's writings for the purpose of improvement.

Interviewing—Students generate questions to ask and arrange an interview with a person who has first-hand knowledge and/or experience with a topic.

Learning Outcomes Structure

The following definitions were used in structuring the framework of learning outcomes.

What Are Learning Outcomes?

Learning outcomes are statements that indicate what learners will know or be able to do as a result of a learning activity. Learning outcomes are usually expressed as knowledge, skills, or attitudes.

Learning outcomes provide direction in the planning of a learning activity. They help to

- focus on the learner's behaviour/action
- serve as guidelines for content, instruction, and assessment
- identify specifically what should be learned
- convey to learners exactly what is to be accomplished

Why Learning Outcomes?

Learning outcomes

- enable students to learn more effectively
- act as a template to enable teachers to design their student materials more effectively
- enable teachers to select the teaching strategy for the intended learning outcome based on student needs
- enable teachers to select the assessment strategy based on the materials delivered

What Are General Learning Outcomes (GLOs)?

GLOs identify the broad categories of knowledge, skills, and attitudes that students are expected to learn and be able to demonstrate in a subject area or course.

In this document many of the GLOs are accompanied by examples. These are meant to be a guide to the breadth and depth of a topic in those sections where teachers are asked to develop their own Specific Learning Outcomes.

What Are Specific Learning Outcomes (SLOs)?

SLOs identify the knowledge, skills, and attitudes that contribute to a GLO. They are to help teachers focus on particular aspects of knowledge and skills as they plan learning activities for their students.

What Are the Characteristics of Good Learning Outcomes?

Learning outcomes have three distinguishing characteristics. The specific action by the learner must be

1. observable
2. measurable
3. obtainable

SENIOR YEARS

General Learning Outcomes

General Learning Outcomes

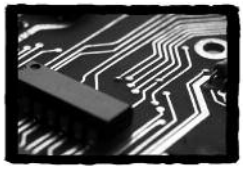
In Industrial Arts Curricula in Manitoba the General Learning Outcomes (GLOs) are grouped into three skill sets:

- **Fundamental Skills**—the skills basic for study in Industrial Arts
- **Personal Skills**—the skills basic for personal effectiveness and growth
- **Production Skills**—the skills basic for production and fabrication

Fundamental Skills and **Personal Skills** contain General Learning Outcomes that are common to all Industrial Arts strands.

Production Skills contain General Learning Outcomes that are focused to each individual Industrial Arts strand.

Drafting Design Technology



Electricity/Electronics Technology

Graphic Communication Technology

Metalwork Technology

Power Mechanics Technology

Woodwork Technology

Fundamental Skills

(the skills basic for study in Industrial Arts—common to all Industrial Arts strands)

General Learning Outcomes

GLO F1 **Technical Communication:** Communicate technical ideas and designs effectively and appropriately.

GLO F2 **Problem Solving:** Apply effective decision-making, problem-solving, and design strategies to a project. (Refer to Appendix B for a sample design/problem-solving process.)

GLO F3 **Information Management:** Effectively manage information.

Personal Skills

(the skills basic for personal effectiveness and growth—common to all Industrial Arts strands)

General Learning Outcomes

GLO P1 **Time Management:** Demonstrate responsibility in time management, task completion, and in meeting project criteria. (Note: based on the Conference Board of Canada's Personal Management Skills)

GLO P2 **Ethical Decision-Making:** Make ethical decisions concerning the impact of one's activities and the use of technology.

GLO P3 **Career Planning:** Develop an action plan relating personal aptitudes and abilities to occupational opportunities.

GLO P4 **Safe Practices:** Demonstrate safe practices with tools, machines, materials, and related processes. (Refer to: *Keeping Your Facilities SAFE: A Support Document for Industrial Arts Teachers,* Manitoba Education and Youth, 2003.)

GLO P5 **Positive Attitude:** Demonstrate positive attitudes to learning in Industrial Arts facilities.

GLO P6 **Teamwork:** Adapt strategies to work effectively, independently, or as a team member to complete a project.

Production Skills

(the skills basic for production and fabrication—focused to each individual Industrial Arts strand)

General Learning Outcomes for Each Strand

Drafting Design Technology

GLO DD1 **Tools and Equipment:** Identify and demonstrate proper use of tools, materials, and equipment utilized in drafting design.

GLO DD2 **Drawing Interpretation:** Recognize and interpret technical drawings.

GLO DD3 **Technical Sketching:** Employ technical sketching as a way of visualizing ideas.

GLO DD4 **Geometric Application:** Apply mathematics and geometry in completing technical drawings.

GLO DD5 **Production (Working) Drawings:** Use the design process and problem solving to create production drawings.

GLO DD6 **Applications:** Develop an understanding of drafting applications and current workplace practice.

GLO DD7 **Current Innovation:** Demonstrate an understanding of current innovation in drafting design processes, applications, and emerging new technologies.

Electricity/Electronics Technology

GLO EE1 **Tools and Equipment:** Identify and demonstrate proper use of tools, materials, and equipment utilized in electricity/electronics.

GLO EE2 **Circuit Construction:** Apply appropriate fabrication techniques to construct electricity/electronics devices.

GLO EE3 **Components:** Demonstrate the function of electricity/electronics passive and active components.

GLO EE4 **Laws and Theory:** Apply electricity/electronics laws and theory.

GLO EE5 **Circuits and Systems:** Identify and analyze basic electricity/electronics circuits.

GLO EE6 **Applications:** Develop an understanding of electricity/electronics applications.

GLO EE7 **Current Innovation:** Demonstrate an understanding of current innovation in electricity/electronics, processes, applications and emerging new technologies.

Graphic Communication Technology

GLO GC1 **Image Acquisition:** Demonstrate the principals and processes involved with image acquisition and creation.

GLO GC2 **Still Image Production:** Apply knowledge and practical skills to produce still image visual representations of ideas or abstract concepts.

GLO GC3 **Binding and Packaging:** Demonstrate and apply the knowledge and skills to finish a product for distribution.

GLO GC4 **Animated Images:** Apply knowledge and skills to produce animated images of ideas or abstract concepts.

GLO GC5 **Video Editing:** Create and edit video productions.

GLO GC6 **Current Innovation:** Demonstrate an understanding of current innovation in graphic communication processes, applications, and emerging new technologies.

Metalwork Technology

GLO MW1 **Metalurgy:** Demonstrate an understanding of metallurgy—science and processes.

GLO MW2 **Measurement and Layout:** Use metalworking measurement and layout tools correctly and efficiently.

GLO MW3 **Separation:** Apply separation processes to metal.

GLO MW4 **Fastening:** Apply fastening processes to metal.

GLO MW5 **Forming and Casting:** Apply forming and casting processes to metal.

GLO MW6 **Finishing:** Apply finishing processes to metal considering their environmental impact.

GLO MW7 **Current Innovation:** Demonstrate an understanding of current innovation in metalwork processes, applications, and emerging new technologies.

Power Mechanics Technology

GLO PM1 **Energy Conversion:** Demonstrate an understanding of the theory of internal combustion and alternate energy converters.

GLO PM2 **Engine Systems:** Identify and analyze various engine systems.

GLO PM3 **Electrical Systems:** Understand the basic electrical principles applied to power mechanics systems.

GLO PM4 **Mechanical Systems:** Identify and analyze the mechanical systems of an internal combustion engine.

GLO PM5 **Chassis Systems:** Identify and compare various automotive chassis systems.

GLO PM6 **Climate Control Systems:** Identify and analyze the climate control systems in an automobile.

GLO PM7 **Assembly/Disassembly Tools:** Demonstrate the use of tools and equipment in assembly and disassembly of mechanical components.

GLO PM8 **Diagnostic Tools:** Use diagnostic tools and methods to troubleshoot, diagnose, and repair power mechanical systems.

GLO PM9 **Environmental Impact and Current Innovation:** Demonstrate an understanding of current innovation in automotive industry, environmental impacts, and emerging new technologies.

Woodwork Technology

GLO WW1 **Wood, Products, and Processes:** Demonstrate an understanding of woodwork— woods, wood products, and processes.

GLO WW2 **Measurement and Layout:** Use woodworking measurement and layout tools, correctly and efficiently.

GLO WW3 **Separation:** Apply separation processes to wood.

GLO WW4 **Fastening:** Apply fastening processes and specialty hardware to wood, correctly and efficiently.

GLO WW5 **Wood Joints:** Apply joints and joining techniques to wood.

GLO WW6 **Finishing:** Apply finishing processes to wood considering their environmental impact.

GLO WW7 **Current Innovation:** Demonstrate an understanding of current innovation in woodwork processes, applications, and emerging new technologies.

SENIOR YEARS

Specific Learning Outcomes

A Guide to Reading Learning Outcome Numbering

Production Skills

General Learning Outcome

GLO DD1 **Tools and Equipment:** Identify and demonstrate proper use of tools, materials, and equipment utilized in Drafting Design.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.DD1.1 Identify and utilize traditional "board" tools used in drafting such as T-squares, drafting machines, set-squares, scales, rules...	IA10.DD1.1 →	IA11.DD1.1 →	IA12.DD1.1 →
IA9.DD1.2 Use a Computer Assisted Drafting and Design (CADD) system to produce a simple technical drawing.	IA10.DD1.2 →	IA11.DD1.2 →	IA12.DD1.2 Convert ideas into 2-D and 3-D drawings using a CADD system and rendering software.
IA9.DD1.3 Demonstrate a working knowledge of various input and output devices in a CADD system.	IA10.DD1.3 →	IA11.DD1.3 →	IA12.DD1.3 Determine hardware and software configuration required to accomplish goals in a specified drafting project.

GLO (General Learning Outcome)

Drafting Design Technology

First General Learning Outcome of this Set

SLO (Specific Learning Outcome)

SLO (Number 3)

Grade 9 Level

First General Learning Outcome of this Set

Drafting Design Technology

SENIOR YEARS

Drafting Design Technology

Fundamental Skills

General Learning Outcome

GLO F1 **Technical Communication:** Communicate technical ideas and designs effectively and appropriately.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.F1.1 Use several presentation programs using existing formats to digitally communicate a technical idea.	IA10.F1.1 Design a simple presentation using a presentation program to communicate a technical idea.	IA11.F1.1 Apply an advanced presentation program effectively to communicate a technical idea visually.	IA12.F1.1 Apply an appropriate combination of digital, graphic, oral, and written techniques to effectively communicate a technical idea.
IA9.F1.2 Interpret a graphic presentation of a technical idea.	IA10.F1.2 Adapt a graphic presentation of a technical idea.	IA11.F1.2 Create a graphic presentation of a technical idea.	
IA9.F1.3 Recognize technical language and terms.	IA10.F1.3 Use technical language and terms in the correct context.	IA11.F1.3 Create a set of steps using correct technical writing techniques to effectively describe a technical process.	
IA9.F1.4 Effectively use technical reading skills to follow a set of instructional steps.	IA10.F1.4 Adapt a set of instructional steps using appropriate technical writing skills.		

Fundamental Skills

General Learning Outcome

GLO F2 **Problem Solving:** Apply effective decision-making, problem-solving, and design strategies to a project. (Refer to Appendix B for a sample design/problem-solving process.)

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.F2.1 Demonstrate an understanding of the problem-solving process in designing and producing a product.	IA10.F2.1 Identify problems and apply appropriate problem-solving skills to solve them.	IA11.F2.1 Transfer problem-solving skills to real-life situations.	IA12.F2.1 Research and articulate a problem that can be solved through technological means.
IA9.F2.2 Identify criteria for making and evaluating choices.	IA10.F2.2 Apply a decision-making strategy to practical situations.	IA11.F2.2 Use a variety of critical thinking skills to evaluate situations and make decisions.	IA12.F2.2 Apply problem-solving and design skills to develop a technological solution to a problem.
IA9.F2.3 Demonstrate an understanding of the qualities of good design.	IA10.F2.3 Modify an existing design to meet specified criteria.	IA11.F2.3 Create a design to meet a set of specifications.	IA12.F2.3 Analyze critically and act logically to evaluate situations and make decisions.

Fundamental Skills

General Learning Outcome

GLO F3 **Information Management:** Effectively manage information.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.F3.1 Acquire and organize information using appropriate technology and information systems.	IA10.F3.1 Apply specialized information and skills in real-life situations.	IA11.F3.1 Transfer and apply specialized information and skills in a variety of situations.	IA12.F3.1 Acquire, analyze, and apply specialized information and skills from various disciplines in a variety of realistic circumstances.
IA9.F3.2 Demonstrate the appropriate use of information as directed.	IA10.F3.2 Access and use a range of relevant information, material, and human resources with limited direction.	IA11.F3.2 Acquire and use a range of relevant information, material, and human resources, and recognize when additional resources are required.	IA12.F3.2 Support and enhance basic information requirements by using a wide variety of information, material, and human resources.

Personal Skills

General Learning Outcome

GLO P1 **Time Management:** Demonstrate responsibility in time management, task completion, and in meeting project criteria. (Note: based on the Conference Board of Canada's Personal Management Skills)

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P1.1 Demonstrate responsibility in time management.	IA10.P1.1 Demonstrate responsibility in time management.	IA11.P1.1 Demonstrate responsibility in time management.	IA12.P1.1 Demonstrate responsibility in time management.
IA9.P1.2 Demonstrate responsibility in being accountable for one's actions.	IA10.P1.2 Demonstrate responsibility in being accountable for one's actions.	IA11.P1.2 Demonstrate responsibility in being accountable for one's actions.	IA12.P1.2 Demonstrate responsibility in being accountable for one's actions.
IA9.P1.3 Arrive at class prepared with materials and completed assignments.	IA10.P1.3 Arrive at class prepared with materials and completed assignments.	IA11.P1.3 Arrive at class prepared with materials and completed assignments.	IA12.P1.3 Arrive at class prepared with materials and completed assignments.
IA9.P1.4 Complete all assigned tasks within stated deadlines.	IA10.P1.4 Complete all assigned tasks within stated deadlines.	IA11.P1.4 Complete all assigned tasks within stated deadlines.	IA12.P1.4 Complete all assigned tasks within stated deadlines.
IA9.P1.5 Complete all projects according to specified criteria.	IA10.P1.5 Complete all projects according to specified criteria.	IA11.P1.5 Complete all projects according to specified criteria.	IA12.P1.5 Complete all projects according to specified criteria.

Personal Skills

General Learning Outcome

GLO P2 **Ethical Decision Making:** Make ethical decisions concerning the impact of one's activities and the use of technology.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P2.1 Make personal judgments whether certain behaviours/actions are right or wrong. IA9.P2.2 Demonstrate an understanding of technological impact on the environment, society, lifestyles, etc.	IA10.P2.1 Assess how personal judgments affect peer members and/or community members. IA10.P2.2 Demonstrate an understanding of the impact of technological choices.	IA11.P2.1 Assess the implications of personal/group actions within the broader community. IA11.P2.2 Develop and implement risk management strategies for a variety of technological activities.	IA12.P2.1 Analyze the implications of personal/group actions within the global context. IA12.P2.2 State and support a personal code of ethics as required. IA12.P2.3 Demonstrate responsible leadership in managing current and future technologies on the environment and on society.

Personal Skills

General Learning Outcome

GLO P3 **Career Planning:** Develop an action plan relating personal aptitudes and abilities to occupational opportunities.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P3.1 Identify critical skills needed for employability in today's workplace.	IA10.P3.1 Evaluate employability profiles for a variety of workplaces and careers.	IA11.P3.1 Develop strategies to assess personal technological literacy and capability.	IA12.P3.1 Assess specific personal skills, interests, and abilities (career portfolio).
IA9.P3.2 Demonstrate an awareness of the technologies of specific occupations and workplaces.	IA10.P3.2 Outline skills required for a specific career path.	IA11.P3.2 Perform an assessment of personal strengths and weaknesses (career portfolio).	IA12.P3.2 Develop a plan for acquiring the technological capabilities required to achieve a career vision (career portfolio).

Personal Skills

General Learning Outcome

GLO P4 **Safe Practices:** Demonstrate safe practices with tools, machines, materials, and related processes. (Refer to: *Keeping Your Facilities SAFE: A Support Document for Industrial Arts Teachers,* Manitoba Education and Youth, 2003.)

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P4.1 Follow personal and environmental health and safety procedures.	IA10.P4.1 Recognize and follow personal and environmental health and safety procedures.	IA11.P4.1 Establish and follow personal and environmental health and safety procedures.	IA12.P4.1 Transfer and apply personal and environmental health and safety procedures to a variety of environments and situations.
IA9.P4.2 Identify immediate hazards and their impact on self, others, and the environment.	IA10.P4.2 Identify immediate and potential hazards and their impact on self, others, and the environment.	IA11.P4.2 Identify immediate and potential hazards and assess their impact on self, others, and the environment.	IA12.P4.2 Identify immediate and potential hazards and assess their impact on self, others, and the environment, and recommend safe procedures.
IA9.P4.3 Identify and follow appropriate emergency response procedures.	IA10.P4.3 Identify and follow appropriate emergency response procedures.	IA11.P4.3 Identify and follow appropriate emergency response procedures.	IA12.P4.3 Identify and follow appropriate emergency response procedures.

Personal Skills

General Learning Outcome

GLO P5 **Positive Attitude:** Demonstrate positive attitudes to learning in Industrial Arts facilities.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P5.1 Listen, in order to understand and learn.	IA10.P5.1 Listen and respond, in order to understand and learn.	IA11.P5.1 Listen and respond, in order to understand, learn, and teach.	IA12.P5.1 Listen and respond, in order to understand, learn, teach, and evaluate.
IA9.P5.2 Demonstrate a willingness to continuously learn.	IA10.P5.2 Assess personal learning needs (i.e., personal learning style).	IA11.P5.2 Identify learning sources and opportunities.	IA12.P5.2 Set learning goals and develop a personal learning plan.
IA9.P5.3 Actively participate in a positive manner.	IA10.P5.3 Actively participate in a positive manner.	IA11.P5.3 Actively participate in a positive manner.	IA12.P5.3 Actively participate in a positive manner.

Personal Skills

General Learning Outcome

GLO P6 **Teamwork:** Adapt strategies to work effectively, independently, or as a team member to complete a project.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P6.1 Demonstrate an understanding of the role of members of a team.	IA10.P6.1 Contribute to a team to achieve its mandate.	IA11.P6.1 Identify the need to lead and/or support in a team situation, in order to achieve the team mandate.	IA12.P6.1 Understand and work with others on a "job" to achieve the best results.
IA9.P6.2 Acknowledge the opinions and contributions of all team members.	IA10.P6.2 Respect the opinions and contributions of all team members.	IA11.P6.2 Seek and appreciate the opinions and contributions of all team members.	IA12.P6.2 Lead and/or support as appropriate to motivate a team for high performance.
IA9.P6.3 List and define team objectives.	IA10.P6.3 Contribute to the development of team objectives and goals.	IA11.P6.3 →	IA12.P6.3 Develop and/or refine a team approach based on needs and benefits.

Production Skills

General Learning Outcome

GLO DD1 **Tools and Equipment:** Identify and demonstrate proper use of tools, materials, and equipment utilized in drafting design.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.DD1.1 Identify and utilize traditional "board" tools used in drafting such as T-squares, drafting machines, set-squares, scales, rules...	IA10.DD1.1 →	IA11.DD1.1 →	IA12.DD1.1 →
IA9.DD1.2 Use a Computer Assisted Drafting and Design (CADD) system to produce a simple technical drawing.	IA10.DD1.2 →	IA11.DD1.2 →	IA12.DD1.2 Convert ideas into 2-D and 3-D drawings using a CADD system and rendering software.
IA9.DD1.3 Demonstrate a working knowledge of various input and output devices in a CADD system.	IA10.DD1.3 →	IA11.DD1.3 →	IA12.DD1.3 Determine hardware and software configuration required to accomplish goals in a specified drafting project.

Production Skills

General Learning Outcome

GLO DD2 **Drawing Interpretation:** Recognize and interpret technical drawings.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.DD2.1 Do a "material take off" from a set of technical drawings.	IA10.DD2.1 Read and utilize information schedules and notations (including title blocks) on technical drawings.	IA11.DD2.1 →	IA12.DD2.1 →
IA9.DD2.2 Identify the main conventions related to simple technical drawings.	IA10.DD2.2 →	IA11.DD2.2 →	IA12.DD2.2 Identify the main conventions related to several types of technical drawings such as product manufacturing, architectural, civil/structural engineering, aeronautical engineering…

Production Skills

General Learning Outcome

GLO DD3 **Technical Sketching:** Employ technical sketching as a way of visualizing ideas.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.DD3.1 Identify specialized technical sketching materials.	IA10.DD3.1 →	IA11.DD3.1 →	IA12.DD3.1 →
IA9.DD3.2 Sketch orthographic and pictorial views of common objects.	IA10.DD3.2 →	IA11.DD3.2 →	IA12.DD3.2 Employ sketching as a way of representing ideas during the planning of all drafting projects.

Production Skills

General Learning Outcome

GLO DD4 **Geometric Application:** Apply mathematics and geometry in completing technical drawings.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.DD4.1 Identify basic geometric shapes and solids.	IA10.DD4.1 Construct basic geometric shapes and solids.	IA11.DD4.1 →	IA12.DD4.1 →
IA9.DD4.2 Recognize and interpret technical drawings containing auxiliary views and sections.	IA10.DD4.2 →	IA11.DD4.2 →	IA12.DD4.2 Identify the appropriate need for auxiliary views and sections in a technical drawing and create them.
IA9.DD4.3 Identify basic geometric developments.	IA10.DD4.3 →	IA11.DD4.3 →	IA12.DD4.3 Create parallel line and radial line developments with and without intersecting shapes.

Production Skills

General Learning Outcome

GLO DD5 **Production (Working) Drawings:** Use the design process and problem solving to create production drawings.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.DD5.1 Identify the common terms and properties of typical mechanical production drawings such as tolerances, surface finish, threaded fastener specifications, welding symbols	IA10.DD5.1 →	IA11.DD5.1 →	IA12.DD5.1 Research, assemble information, and develop a solution by creating a mechanical production drawing.
IA9.DD5.2 Identify the common terms and properties of typical building construction drawings such as presentation drawings, construction drawings, plan views, elevations, finish schedules, perspective projection …	IA10.DD5.2 →	IA11.DD5.2 →	IA12.DD5.2 Research, assemble information, and develop a solution by creating a building construction drawing.
IA9.DD5.3 Identify the common terms and properties of typical electricity/electronics and piping fluidic drawings such as schematic symbols, pictorial connection diagrams, single line pipe diagrams …	IA10.DD5.3 →	IA11.DD5.3 →	IA12.DD5.3 Research, assemble information, and develop a solution by creating a electricity/electronics drawing.

Continued

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.DD5.4 Identify the common terms and properties of typical technical illustration/sales drawings such as shading, exploded pictorial, wash rendering, charting …	IA10.DD5.4 ➔	IA11.DD5.4 ➔	IA12.DD5.4 Research, assemble information, and develop a solution by creating a technical illustration/sales drawing.
IA9.DD5.5 Identify the common terms and properties of typical geological/ topographical drawings such as cadastral maps, plot survey, contour mapping …	IA10.DD5.5 ➔	IA11.DD5.5 ➔	IA12.DD5.5 Research, assemble information, and develop a solution by creating a geological/ topographical drawing.

Production Skills

General Learning Outcome

GLO DD6 **Applications:** Develop an understanding of drafting applications and current workplace practice.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.DD6.1 Identify the common terms and practices associated with product manufacturing drafting such as detail working drawings, assembly drawings, scale models, and prototypes …	IA10.DD6.1 →	IA11.DD6.1 →	IA12.DD6.1 Combine knowledge of production drawings, good design process, and teamwork to create a series of drawings and models as a solution to a product manufacturing challenge.
IA9.DD6.2 Identify the common terms and practices associated with architectural drafting such as architectural lettering, architectural styles, house construction, architectural scale models …	IA10.DD6.2 →	IA11.DD6.2 →	IA12.DD6.2 Combine knowledge of production drawings, good design process, and teamwork to create a series of drawings as a solution to an architectural project challenge.
IA9.DD6.3 Identify the common terms and practices associated with engineering drafting such as community plans, surveys, steel structure cross sections, sheet metal, jigs, fixtures …	IA10.DD6.3 →	IA11.DD6.3 →	IA12.DD6.3 Combine knowledge of production drawings, good design process, and teamwork to create a series of drawings as a solution to an engineering project challenge.

Production Skills

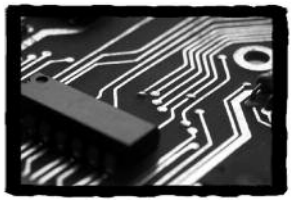
General Learning Outcome

GLO DD7 **Current Innovation:** Demonstrate an understanding of current innovation in drafting design processes, applications, and emerging new technologies.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.DD7.1 Identify several current innovations in drafting design such as virtual walkthrough software, 3-D prototype printing, 3-D solid modelling drafting …	IA10.DD7.1 →	IA11.DD7.1 →	IA12.DD7.1 Research, explain, and demonstrate several current innovations in drafting design.

Senior Years

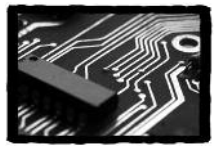
Electricity/Electronics Technology



Fundamental Skills

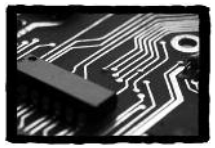
General Learning Outcome

GLO F1 **Technical Communication:** Communicate technical ideas and designs effectively and appropriately



Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.F1.1 Use several presentation programs using existing formats to digitally communicate a technical idea.	IA10.F1.1 Design a simple presentation using a presentation program to communicate a technical idea.	IA11.F1.1 Apply an advanced presentation program effectively to communicate a technical idea visually.	IA12.F1.1 Apply an appropriate combination of digital, graphic, oral, and written techniques to effectively communicate a technical idea.
IA9.F1.2 Interpret a graphic presentation of a technical idea.	IA10.F1.2 Adapt a graphic presentation of a technical idea.	IA11.F1.2 Create a graphic presentation of a technical idea.	
IA9.F1.3 Recognize technical language and terms.	IA10.F1.3 Use technical language and terms in the correct context.	IA11.F1.3 Create a set of steps using correct technical writing techniques to effectively describe a technical process.	
IA9.F1.4 Effectively use technical reading skills to follow a set of instructional steps.	IA10.F1.4 Adapt a set of instructional steps using appropriate technical writing skills.		

Fundamental Skills



General Learning Outcome

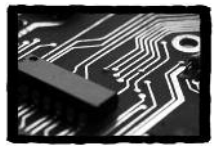
GLO F2 **Problem Solving:** Apply effective decision-making, problem-solving, and design strategies to a project. (Refer to Appendix B for a sample design/problem-solving process.)

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.F2.1 Demonstrate an understanding of the problem-solving process in designing and producing a product.	IA10.F2.1 Identify problems and apply appropriate problem-solving skills to solve them.	IA11.F2.1 Transfer problem-solving skills to real-life situations.	IA12.F2.1 Research and articulate a problem that can be solved through technological means.
IA9.F2.2 Identify criteria for making and evaluating choices.	IA10.F2.2 Apply a decision-making strategy to practical situations.	IA11.F2.2 Use a variety of critical thinking skills to evaluate situations and make decisions.	IA12.F2.2 Apply problem-solving and design skills to develop a technological solution to a problem.
IA9.F2.3 Demonstrate an understanding of the qualities of good design.	IA10.F2.3 Modify an existing design to meet specified criteria.	IA11.F2.3 Create a design to meet a set of specifications.	IA12.F2.3 Analyze critically and act logically to evaluate situations and make decisions.

Fundamental Skills

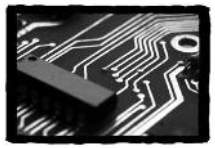
General Learning Outcome

GLO F3 **Information Management:** Effectively manage information.



Grade 9 Specific Learning Outcome(s)	Grade 10 Specific Learning Outcome(s)	Grade 11 Specific Learning Outcome(s)	Grade 12 Specific Learning Outcome(s)
IA9.F3.1 Acquire and organize information using appropriate technology and information systems.	IA10.F3.1 Apply specialized information and skills in real-life situations.	IA11.F3.1 Transfer and apply specialized information and skills in a variety of situations.	IA12.F3.1 Acquire, analyze, and apply specialized information and skills from various disciplines in a variety of realistic circumstances.
IA9.F3.2 Demonstrate the appropriate use of information as directed.	IA10.F3.2 Access and use a range of relevant information, material, and human resources with limited direction.	IA11.F3.2 Acquire and use a range of relevant information, material, and human resources, and recognize when additional resources are required.	IA12.F3.2 Support and enhance basic information requirements by using a wide variety of information, material, and human resources.

Personal Skills



General Learning Outcome

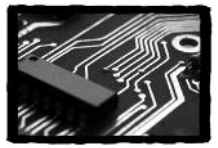
GLO P1 **Time Management:** Demonstrate responsibility in time management, task completion, and in meeting project criteria. (Note: based on the Conference Board of Canada's Personal Management Skills)

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P1.1 Demonstrate responsibility in time management.	IA10.P1.1 Demonstrate responsibility in time management.	IA11.P1.1 Demonstrate responsibility in time management.	IA12.P1.1 Demonstrate responsibility in time management.
IA9.P1.2 Demonstrate responsibility in being accountable for one's actions.	IA10.P1.2 Demonstrate responsibility in being accountable for one's actions.	IA11.P1.2 Demonstrate responsibility in being accountable for one's actions.	IA12.P1.2 Demonstrate responsibility in being accountable for one's actions.
IA9.P1.3 Arrive at class prepared with materials and completed assignments.	IA10.P1.3 Arrive at class prepared with materials and completed assignments.	IA11.P1.3 Arrive at class prepared with materials and completed assignments.	IA12.P1.3 Arrive at class prepared with materials and completed assignments.
IA9.P1.4 Complete all assigned tasks within stated deadlines.	IA10.P1.4 Complete all assigned tasks within stated deadlines.	IA11.P1.4 Complete all assigned tasks within stated deadlines.	IA12.P1.4 Complete all assigned tasks within stated deadlines.
IA9.P1.5 Complete all projects according to specified criteria.	IA10.P1.5 Complete all projects according to specified criteria.	IA11.P1.5 Complete all projects according to specified criteria.	IA12.P1.5 Complete all projects according to specified criteria.

Personal Skills

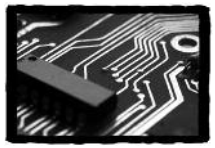
General Learning Outcome

GLO P2 **Ethical Decision Making:** Make ethical decisions concerning the impact of one's activities and the use of technology.



Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P2.1 Make personal judgments whether certain behaviours/actions are right or wrong.	IA10.P2.1 Assess how personal judgments affect peer members and/or community members.	IA11.P2.1 Assess the implications of personal/group actions within the broader community.	IA12.P2.1 Analyze the implications of personal/group actions within the global context.
IA9.P2.2 Demonstrate an understanding of technological impact on the environment, society, lifestyles, etc.	IA10.P2.2 Demonstrate an understanding of the impact of technological choices.	IA11.P2.2 Develop and implement risk management strategies for a variety of technological activities.	IA12.P2.2 State and support a personal code of ethics as required.
			IA12.P2.3 Demonstrate responsible leadership in managing current and future technologies on the environment and on society.

Personal Skills



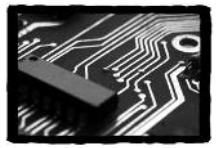
General Learning Outcome

GLO P3 **Career Planning:** Develop an action plan relating personal aptitudes and abilities to occupational opportunities.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P3.1 Identify critical skills needed for employability in today's workplace.	IA10.P3.1 Evaluate employability profiles for a variety of workplaces and careers.	IA11.P3.1 Develop strategies to assess personal technological literacy and capability.	IA12.P3.1 Assess specific personal skills, interests, and abilities (career portfolio).
IA9.P3.2 Demonstrate an awareness of the technologies of specific occupations and workplaces.	IA10.P3.2 Outline skills required for a specific career path.	IA11.P3.2 Perform an assessment of personal strengths and weaknesses (career portfolio).	IA12.P3.2 Develop a plan for acquiring the technological capabilities required to achieve a career vision (career portfolio).

Personal Skills

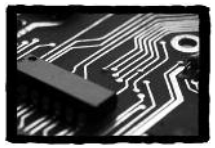
General Learning Outcome



GLO P4 **Safe Practices:** Demonstrate safe practices with tools, machines, materials, and related processes. (Refer to: Keeping Your Facilities SAFE: A Support Document for Industrial Arts Teachers, Manitoba Education and Youth, 2003.)

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P4.1 Follow personal and environmental health and safety procedures.	IA10.P4.1 Recognize and follow personal and environmental health and safety procedures.	IA11.P4.1 Establish and follow personal and environmental health and safety procedures.	IA12.P4.1 Transfer and apply personal and environmental health and safety procedures to a variety of environments and situations.
IA9.P4.2 Identify immediate hazards and their impact on self, others, and the environment.	IA10.P4.2 Identify immediate and potential hazards and their impact on self, others, and the environment.	IA11.P4.2 Identify immediate and potential hazards and assess their impact on self, others, and the environment.	IA12.P4.2 Identify immediate and potential hazards and assess their impact on self, others, and the environment, and recommend safe procedures.
IA9.P4.3 Identify and follow appropriate emergency response procedures.	IA10.P4.3 Identify and follow appropriate emergency response procedures.	IA11.P4.3 Identify and follow appropriate emergency response procedures.	IA12.P4.3 Identify and follow appropriate emergency response procedures.

Personal Skills



General Learning Outcome

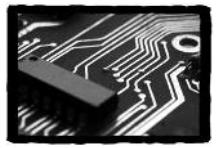
GLO P5 **Positive Attitude:** Demonstrate positive attitudes to learning in Industrial Arts facilities.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P5.1 Listen, in order to understand and learn.	IA10.P5.1 Listen and respond, in order to understand and learn.	IA11.P5.1 Listen and respond, in order to understand, learn and teach.	IA12.P5.1 Listen and respond, in order to understand, learn, teach, and evaluate.
IA9.P5.2 Demonstrate a willingness to continuously learn.	IA10.P5.2 Assess personal learning needs (i.e., personal learning style).	IA11.P5.2 Identify learning sources and opportunities.	IA12.P5.2 Set learning goals and develop a personal learning plan.
IA9.P5.3 Actively participate in a positive manner.	IA10.P5.3 Actively participate in a positive manner.	IA11.P5.3 Actively participate in a positive manner.	IA12.P5.3 Actively participate in a positive manner.

Personal Skills

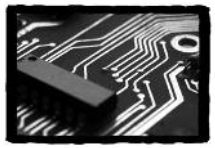
General Learning Outcome

GLO P6 **Teamwork:** Adapt strategies to work effectively, independently, or as a team member to complete a project.



Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P6.1 Demonstrate an understanding of the role of members of a team.	IA10.P6.1 Contribute to a team to achieve its mandate.	IA11.P6.1 Identify the need to lead and/or support in a team situation, in order to achieve the team mandate.	IA12.P6.1 Understand and work with others on a "job" to achieve the best results.
IA9.P6.2 Acknowledge the opinions and contributions of all team members.	IA10.P6.2 Respect the opinions and contributions of all team members.	IA11.P6.2 Seek and appreciate the opinions and contributions of all team members.	IA12.P6.2 Lead and/or support as appropriate to motivate a team for high performance.
IA9.P6.3 List and define team objectives.	IA10.P6.3 Contribute to the development of team objectives and goals.	IA11.P6.3 →	IA12.P6.3 Develop and/or refine a team approach based on needs and benefits.

Production Skills



General Learning Outcome

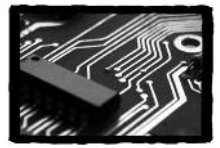
GLO EE1 **Tools and Equipment:** Identify and demonstrate proper use of tools, materials, and equipment utilized in electricity/electronics.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.EE1.1 Identify and utilize common hand tools used in electricity/electronics.	IA10.EE1.1 →	IA11.EE1.1 →	IA12.EE1.1 →
IA9.EE1.2 Identify and utilize several common pieces of test equipment used in electricity/electronics such as ohmmeters, ammeters, voltmeters, power supplies...	IA10.EE1.2 →	IA11.EE1.2 →	IA12.EE1.2 Identify and utilize most common pieces of test equipment used in electricity/electronics including several specialized pieces of test equipment such as programmable power supplies, function/pulse/signal generators, component measuring devices, frequency counters, spectrum analyzers, logic analyzers….
IA9.EE1.3 Select appropriate test equipment to measure specified functions of an electricity/electronics circuit.	IA10.EE1.3 →	IA11.EE1.3 →	IA12.EE1.3 Apply appropriate test equipment techniques to the analysis, repair, and calibration of electricity/electronics circuits and devices.

Production Skills

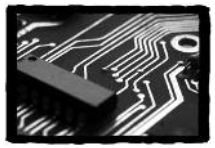
General Learning Outcome

GLO EE2 **Circuit Construction:** Apply appropriate fabrication techniques to construct electricity/electronics devices.



Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.EE2.1 Use correct procedures to solder basic electricity/electronics circuitry.	IA10.EE2.1 →	IA11.EE2.1 →	IA12.EE2.1 Use correct procedures to solder electricity/electronics circuitry including unique and heat sensitive circuits.
IA9.EE2.2 Breadboard simple circuits from given schematic diagrams.	IA10.EE2.2 →	IA11.EE2.2 →	IA12.EE2.2 Breadboard complex circuits from given schematic diagrams.
IA9.EE2.3 Construct simple printed circuits.	IA10.EE2.3 →	IA11.EE2.3 →	IA12.EE2.3 Design, plan, and construct complex printed circuits.
IA9.EE2.4 Troubleshoot and repair simple electricity/ electronics circuitry.	IA10.EE2.4 →	IA11.EE2.4 →	IA12.EE2.4 Troubleshoot and repair complex electricity/ electronics circuitry.

Production Skills



General Learning Outcome

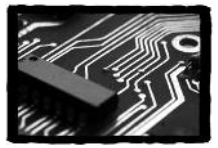
GLO EE3 **Components:** Demonstrate the function of electricity/electronics passive and active components.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.EE3.1 Identify common electricity/electronics passive and active components such as resistors, conductors, semiconductors, control devices...	IA10.EE3.1 →	IA11.EE3.1 →	IA12.EE3.1 Describe the function, properties, and schematic symbols of most common electricity/electronics passive and active components.
IA9.EE3.2 Select appropriate components for a circuit given a schematic diagram.	IA10.EE3.2 →	IA11.EE3.2 →	IA12.EE3.2 →

Production Skills

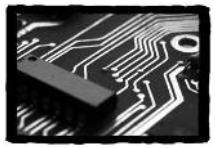
General Learning Outcome

GLO EE4 **Laws and Theory:** Apply electricity/electronics laws and theory.



Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.EE4.1 Demonstrate an understanding of basic electrical laws and formulas such as Ohm's Law, Watt's Law, the law of magnetism…	IA10.EE4.1 →	IA11.EE4.1 →	IA12.EE4.1 Apply mathematical calculations and formulas to analyze electricity/ electronics circuitry.
IA9.EE4.2 Demonstrate an understanding of basic DC electrical theory including concepts such as the atomic model, electrons, current, electromotive force, potential difference, volt, resistance, inductance…	IA10.EE4.2 →	IA11.EE4.2 →	IA12.EE4.2 Apply DC theory to analyze electricity/electronics circuitry.
IA9.EE4.3 Demonstrate an understanding of basic AC electrical theory including concepts such as sine wave, AC generation, hertz, induction, capacitive reactance…	IA10.EE4.3 →	IA11.EE4.3 →	IA12.EE4.3 Apply AC theory to analyze electricity/electronics circuitry.

Production Skills



General Learning Outcome

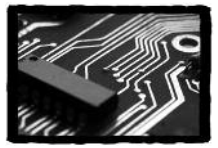
GLO EE5 **Circuits and Systems:** Identify and analyze basic electricity/electronics circuits.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.EE5.1 Identify basic electricity/electronics circuits such as series, parallel, combination, rectifier, oscillator, amplifier, pulse, logic…	IA10.EE5.1 →	IA11.EE5.1 →	IA12.EE5.1 Design and troubleshoot basic electricity/ electronics circuits.
IA9.EE5.2 Identify basic circuits within electricity/ electronics systems such as power control devices, signal producing-receiving devices, analog, and digital systems…	IA10.EE5.2 →	IA11.EE5.2 →	IA12.EE5.2 Combine basic electricity/electronics circuitry to produce systems that achieve specified functions.
IA9.EE5.3 Produce schematic and/or block diagrams of electricity/ electronics circuits and systems.	IA10.EE5.3 →	IA11.EE5.3 →	IA12.EE5.3 →

Production Skills

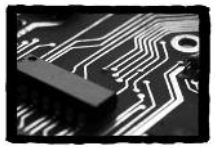
General Learning Outcome

GLO EE6 **Applications:** Develop an understanding of electricity/electronics applications.



Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.EE6.1 Identify basic circuitry and systems used in simple real-world electricity/ electronics applications such as alarm systems, residential wiring, radio, television, digital logic circuits…	IA10.EE6.1 →	IA11.EE6.1 →	IA12.EE6.1 Combine electricity/electronics circuits and systems to create electricity/electronics devices and applications that perform specific functions.
IA9.EE6.2 Troubleshoot and repair basic electricity/ electronics systems and applications.	IA10.EE6.2 →	IA11.EE6.2 →	IA12.EE6.2 →

Production Skills



General Learning Outcome

GLO EE7 **Current Innovation:** Demonstrate an understanding of current innovation in electricity/electronics processes, applications, and emerging new technologies.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.EE7.1 Identify several current innovations in electricity/electronics such as Computer Numerical Control, robotics and automation, digital communication, fibre optic networks, Nano-technology, circuit simulation software …	IA10.EE7.1 →	IA11.EE7.1 →	IA12.EE7.1 Research, explain, and demonstrate several current innovations in electricity/electronics.

SENIOR YEARS

Graphic Communication Technology

Fundamental Skills

General Learning Outcome

GLO F1 **Technical Communication:** Communicate technical ideas and designs effectively and appropriately.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.F1.1 Use several presentation programs using existing formats to digitally communicate a technical idea.	IA10.F1.1 Design a simple presentation using a presentation program to communicate a technical idea.	IA11.F1.1 Apply an advanced presentation program effectively to communicate a technical idea visually.	IA12.F1.1 Apply an appropriate combination of digital, graphic, oral, and written techniques to effectively communicate a technical idea.
IA9.F1.2 Interpret a graphic presentation of a technical idea.	IA10.F1.2 Adapt a graphic presentation of a technical idea.	IA11.F1.2 Create a graphic presentation of a technical idea.	
IA9.F1.3 Recognize technical language and terms.	IA10.F1.3 Use technical language and terms in the correct context.	IA11.F1.3 Create a set of steps using correct technical writing techniques to effectively describe a technical process.	
IA9.F1.4 Effectively use technical reading skills to follow a set of instructional steps.	IA10.F1.4 Adapt a set of instructional steps using appropriate technical writing skills.		

Fundamental Skills

General Learning Outcome

GLO F2: **Problem Solving:** Apply effective decision-making, problem-solving, and design strategies to a project. (Refer to Appendix B for a sample design/problem-solving process.)

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.F2.1 Demonstrate an understanding of the problem-solving process in designing and producing a product.	IA10.F2.1 Identify problems and apply appropriate problem-solving skills to solve them.	IA11.F2.1 Transfer problem-solving skills to real-life situations.	IA12.F2.1 Research and articulate a problem that can be solved through technological means.
IA9.F2.2 Identify criteria for making and evaluating choices.	IA10.F2.2 Apply a decision-making strategy to practical situations.	IA11.F2.2 Use a variety of critical thinking skills to evaluate situations and make decisions.	IA12.F2.2 Apply problem-solving and design skills to develop a technological solution to a problem.
IA9.F2.3 Demonstrate an understanding of the qualities of good design.	IA10.F2.3 Modify an existing design to meet specified criteria.	IA11.F2.3 Create a design to meet a set of specifications.	IA12.F2.3 Analyze critically and act logically to evaluate situations and make decisions.

Fundamental Skills

General Learning Outcome

GLO F3 **Information Management:** Effectively manage information.

Grade 9 Specific Learning Outcome(s)	Grade 10 Specific Learning Outcome(s)	Grade 11 Specific Learning Outcome(s)	Grade 12 Specific Learning Outcome(s)
IA9.F3.1 Acquire and organize information using appropriate technology and information systems.	IA10.F3.1 Apply specialized information and skills in real-life situations.	IA11.F3.1 Transfer and apply specialized information and skills in a variety of situations.	IA12.F3.1 Acquire, analyze, and apply specialized information and skills from various disciplines in a variety of realistic circumstances.
IA9.F3.2 Demonstrate the appropriate use of information as directed.	IA10.F3.2 Access and use a range of relevant information, material, and human resources with limited direction.	IA11.F3.2 Acquire and use a range of relevant information, material, and human resources, and recognize when additional resources are required.	IA12.F3.2 Support and enhance basic information requirements by using a wide variety of information, material, and human resources.

Personal Skills

General Learning Outcome

GLO P1 **Time Management:** Demonstrate responsibility in time management, task completion, and in meeting project criteria. (Note: based on the Conference Board of Canada's Personal Management Skills)

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P1.1 Demonstrate responsibility in time management.	IA10.P1.1 Demonstrate responsibility in time management.	IA11.P1.1 Demonstrate responsibility in time management.	IA12.P1.1 Demonstrate responsibility in time management.
IA9.P1.2 Demonstrate responsibility in being accountable for one's actions.	IA10.P1.2 Demonstrate responsibility in being accountable for one's actions.	IA11.P1.2 Demonstrate responsibility in being accountable for one's actions.	IA12.P1.2 Demonstrate responsibility in being accountable for one's actions.
IA9.P1.3 Arrive at class prepared with materials and completed assignments.	IA10.P1.3 Arrive at class prepared with materials and completed assignments.	IA11.P1.3 Arrive at class prepared with materials and completed assignments.	IA12.P1.3 Arrive at class prepared with materials and completed assignments.
IA9.P1.4 Complete all assigned tasks within stated deadlines.	IA10.P1.4 Complete all assigned tasks within stated deadlines.	IA11.P1.4 Complete all assigned tasks within stated deadlines.	IA12.P1.4 Complete all assigned tasks within stated deadlines.
IA9.P1.5 Complete all projects according to specified criteria.	IA10.P1.5 Complete all projects according to specified criteria.	IA11.P1.5 Complete all projects according to specified criteria.	IA12.P1.5 Complete all projects according to specified criteria.

Personal Skills

General Learning Outcome

GLO P2 **Ethical Decision Making:** Make ethical decisions concerning the impact of one's activities and the use of technology.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P2.1 Make personal judgments whether certain behaviours/actions are right or wrong.	IA10.P2.1 Assess how personal judgments affect peer members and/or community members.	IA11.P2.1 Assess the implications of personal/group actions within the broader community.	IA12.P2.1 Analyze the implications of personal/group actions within the global context.
IA9.P2.2 Demonstrate an understanding of technological impact on the environment, society, lifestyles, etc.	IA10.P2.2 Demonstrate an understanding of the impact of technological choices.	IA11.P2.2 Develop and implement risk management strategies for a variety of technological activities.	IA12.P2.2 State and support a personal code of ethics as required. IA12.P2.3 Demonstrate responsible leadership in managing current and future technologies on the environment and on society.

Personal Skills

General Learning Outcome

GLO P3 **Career Planning:** Develop an action plan relating personal aptitudes and abilities to occupational opportunities.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P3.1 Identify critical skills needed for employability in today's workplace.	IA10.P3.1 Evaluate employability profiles for a variety of workplaces and careers.	IA11.P3.1 Develop strategies to assess personal technological literacy and capability.	IA12.P3.1 Assess specific personal skills, interests, and abilities (career portfolio).
IA9.P3.2 Demonstrate an awareness of the technologies of specific occupations and workplaces.	IA10.P3.2 Outline skills required for a specific career path.	IA11.P3.2 Perform an assessment of personal strengths and weaknesses (career portfolio).	IA12.P3.2 Develop a plan for acquiring the technological capabilities required to achieve a career vision (career portfolio).

Personal Skills

General Learning Outcome

GLO P4 **Safe Practices:** Demonstrate safe practices with tools, machines, materials, and related processes. (Refer to: Keeping Your Facilities SAFE: A Support Document for Industrial Arts Teachers, Manitoba Education and Youth, 2003.)

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P4.1 Follow personal and environmental health and safety procedures.	IA10.P4.1 Recognize and follow personal and environmental health and safety procedures.	IA11.P4.1 Establish and follow personal and environmental health and safety procedures.	IA12.P4.1 Transfer and apply personal and environmental health and safety procedures to a variety of environments and situations.
IA9.P4.2 Identify immediate hazards and their impact on self, others, and the environment.	IA10.P4.2 Identify immediate and potential hazards and their impact on self, others, and the environment.	IA11.P4.2 Identify immediate and potential hazards and assess their impact on self, others, and the environment.	IA12.P4.2 Identify immediate and potential hazards and assess their impact on self, others, and the environment, and recommend safe procedures.
IA9.P4.3 Identify and follow appropriate emergency response procedures.	IA10.P4.3 Identify and follow appropriate emergency response procedures.	IA11.P4.3 Identify and follow appropriate emergency response procedures.	IA12.P4.3 Identify and follow appropriate emergency response procedures.

Personal Skills

General Learning Outcome

GLO P5 **Positive Attitude:** Demonstrate positive attitudes to learning in Industrial Arts facilities.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P5.1 Listen, in order to understand and learn.	IA10.P5.1 Listen and respond, in order to understand and learn.	IA11.P5.1 Listen and respond, in order to understand, learn and teach.	IA12.P5.1 Listen and respond, in order to understand, learn, teach, and evaluate.
IA9.P5.2 Demonstrate a willingness to continuously learn.	IA10.P5.2 Assess personal learning needs (i.e., personal learning style).	IA11.P5.2 Identify learning sources and opportunities.	IA12.P5.2 Set learning goals and develop a personal learning plan.
IA9.P5.3 Actively participate in a positive manner.	IA10.P5.3 Actively participate in a positive manner.	IA11.P5.3 Actively participate in a positive manner.	IA12.P5.3 Actively participate in a positive manner.

Personal Skills

General Learning Outcome

GLO P6 **Teamwork:** Adapt strategies to work effectively, independently, or as a team member to complete a project.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P6.1 Demonstrate an understanding of the role of members of a team.	IA10.P6.1 Contribute to a team to achieve its mandate.	IA11.P6.1 Identify the need to lead and/or support in a team situation, in order to achieve the team mandate.	IA12.P6.1 Understand and work with others on a "job" to achieve the best results.
IA9.P6.2 Acknowledge the opinions and contributions of all team members.	IA10.P6.2 Respect the opinions and contributions of all team members.	IA11.P6.2 Seek and appreciate the opinions and contributions of all team members.	IA12.P6.2 Lead and/or support as appropriate to motivate a team for high performance.
IA9.P6.3 List and define team objectives.	IA10.P6.3 Contribute to the development of team objectives and goals.	IA11.P6.3 →	IA12.P6.3 Develop and/or refine a team approach based on needs and benefits.

Production Skills

General Learning Outcome

GLO GC1 **Image Acquisition:** Demonstrate the principals and processes involved with image acquisition and creation.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.GC1.1 Identify several methods of acquiring and creating images such as scanning, digital photography, using clip art …	IA10.GC1.1 →	IA11.GC1.1 →	IA12.GC1.1 Acquire and modify images using appropriate methods.
IA9.GC1.2 Create raster graphic images.	IA10.GC1.2 →	IA11.GC1.2 →	IA12.GC1.2 →
IA9.GC1.3 Create vector graphic images.	IA10.GC1.3 →	IA11.GC1.3 →	IA12.GC1.3 →

Production Skills

General Learning Outcome

GLO GC2 **Still Image Production:** Apply knowledge and practical skills to produce still image visual representations of ideas or abstract concepts.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.GC2.1 Identify the procedures required for producing a visual representation by relief printing.	IA10.GC2.1 →	IA11.GC2.1 →	IA12.GC2.1 Use several types of relief printing appropriately to create visual representations.
IA9.GC2.2 Identify the procedures required for producing a visual representation by screen printing.	IA10.GC2.2 →	IA11.GC2.2 →	IA12.GC2.2 Use several types of screen printing appropriately to create visual representations.
IA9.GC2.3 Identify the procedures required for producing a visual representation by lithography.	IA10.GC2.3 →	IA11.GC2.3 →	IA12.GC2.3 Use several types of lithography appropriately to create visual representations.
IA9.GC2.4 Identify the procedures required for producing a visual representation by continuous tone and process photography.	IA10.GC2.4 →	IA11.GC2.4 →	IA12.GC2.4 Use several types of continuous and process photography appropriately to create visual representations.
IA9.GC2.5 Identify the procedures required for producing a visual representation by electronic media.	IA10.GC2.5 →	IA11.GC2.5 →	IA12.GC2.5 Use several types of relief printing appropriately to create visual representations.

Production Skills

General Learning Outcome

GLO GC3 **Binding and Packaging:** Demonstrate and apply the knowledge and skills to finish a product for distribution.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.GC3.1 Identify several methods of binding such as stapling, gum binding, coil binding, stitching...	IA10.GC3.1 →	IA11.GC3.1 →	IA12.GC3.1 Bind a printed run using an appropriate method to fulfill a specific set of requirements.
IA9.GC3.2 Identify several packaging methods and systems such as applying covers, folding, collating …	IA10.GC3.2 →	IA11.GC3.2 →	IA12.GC3.2 Determine and apply appropriate packaging to fulfill a specific set of document requirements..

Production Skills

General Learning Outcome

GLO GC4 **Animated Images:** Apply knowledge and skills to produce animated images of ideas or abstract concepts.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.GC4.1 Demonstrate an understanding of and use basic animation terms such as storyboarding, cels, fielding, hand inking, frame rate, embed, tweening …	IA10.GC4.1 →	IA11.GC4.1 →	IA12.GC4.1 →
IA9.GC4.2 Identify and explain several 2-D methods of animation such as hand-drawn cels, cut-out animation, computer-drawn frames …	IA10.GC4.2 →	IA11.GC4.2 →	IA12.GC4.2 Create a 2-D animation using an appropriate method to fulfill a specific set of requirements.
IA9.GC4.3 Identify and explain several 3-D methods of animation such as claymation, stop action, live, digital animation, 3-D computer animation …	IA10.GC4.3 →	IA11.GC4.3 →	IA12.GC4.3 Create a 3-D animation using an appropriate method to fulfill a specific set of requirements.

Production Skills

General Learning Outcome

GLO GC5 **Video Editing:** Create and edit video productions.

Grade 9 Specific Learning Outcome(s)	Grade 10 Specific Learning Outcome(s)	Grade 11 Specific Learning Outcome(s)	Grade 12 Specific Learning Outcome(s)
IA9.GC5.1 Demonstrate an understanding of and use basic video production terms such as storyboarding, scripting, continuity, non-linear editing, NTSC, PAL …	IA10.GC5.1 →	IA11.GC5.1 →	IA12.GC5.2 →
IA9.GC5.2 Identify the steps and requirements of video pre-production such as storyboarding, scripting, set preparation …	IA10.GC5.2 →	IA11.GC5.2 →	IA12.GC5.3 Combine production knowledge, good design process, and teamwork to complete the pre-production work for a video project.
IA9.GC5.3 Identify the steps and requirements of video production such as camera operation, lighting, sound, continuity, production management …	IA10.GC5.3 →	IA11.GC5.3 →	IA12.GC5.4 Combine production knowledge, good design process, and teamwork to complete the production work for a video project.
IA9.GC5.4 Identify the steps and requirements of video editing such as log and capturing, timelines, clips, transitions, effects, titles …	IA10.GC5.4 →	IA11.GC5.4 →	IA12.GC5.5 Combine production knowledge, good design process, and teamwork to complete the post-production work for a video project.

Production Skills

General Learning Outcome

GLO GC6 **Current Innovation:** Demonstrate an understanding of current innovation in graphic communication processes, applications, and emerging new technologies.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.GC6.1 Identify several current innovations in graphic communication such as wide-format printing, interactive graphics, 3-D animation multi-camera motion capture …	IA10.GC6.1 →	IA11.GC6.1 →	IA12.GC6.1 Research, explain, and demonstrate several current innovations in graphic communication.

SENIOR YEARS

Metalwork Technology

Fundamental Skills

General Learning Outcome

GLO F1 **Technical Communication:** Communicate technical ideas and designs effectively and appropriately.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.F1.1 Use several presentation programs using existing formats to digitally communicate a technical idea.	IA10.F1.1 Design a simple presentation using a presentation program to communicate a technical idea.	IA11.F1.1 Apply an advanced presentation program effectively to communicate a technical idea visually.	IA12.F1.1 Apply an appropriate combination of digital, graphic, oral, and written techniques to effectively communicate a technical idea.
IA9.F1.2 Interpret a graphic presentation of a technical idea.	IA10.F1.2 Adapt a graphic presentation of a technical idea.	IA11.F1.2 Create a graphic presentation of a technical idea.	
IA9.F1.3 Recognize technical language and terms.	IA10.F1.3 Use technical language and terms in the correct context.	IA11.F1.3 Create a set of steps using correct technical writing techniques to effectively describe a technical process.	
IA9.F1.4 Effectively use technical reading skills to follow a set of instructional steps.	IA10.F1.4 Adapt a set of instructional steps using appropriate technical writing skills.		

Fundamental Skills

General Learning Outcome

GLO F2 **Problem Solving:** Apply effective decision-making, problem-solving, and design strategies to a project. (Refer to Appendix B for a sample design/problem-solving process.)

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.F2.1 Demonstrate an understanding of the problem-solving process in designing and producing a product.	IA10.F2.1 Identify problems and apply appropriate problem-solving skills to solve them.	IA11.F2.1 Transfer problem-solving skills to real-life situations.	IA12.F2.1 Research and articulate a problem that can be solved through technological means.
IA9.F2.2 Identify criteria for making and evaluating choices.	IA10.F2.2 Apply a decision-making strategy to practical situations.	IA11.F2.2 Use a variety of critical thinking skills to evaluate situations and make decisions.	IA12.F2.2 Apply problem-solving and design skills to develop a technological solution to a problem.
IA9.F2.3 Demonstrate an understanding of the qualities of good design.	IA10.F2.3 Modify an existing design to meet specified criteria.	IA11.F2.3 Create a design to meet a set of specifications.	IA12.F2.3 Analyze critically and act logically to evaluate situations and make decisions.

Fundamental Skills

General Learning Outcome

GLO F3 **Information Management:** Effectively manage information.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.F3.1 Acquire and organize information using appropriate technology and information systems.	IA10.F3.1 Apply specialized information and skills in real-life situations.	IA11.F3.1 Transfer and apply specialized information and skills in a variety of situations.	IA12.F3.1 Acquire, analyze, and apply specialized information and skills from various disciplines in a variety of realistic circumstances.
IA9.F3.2 Demonstrate the appropriate use of information as directed.	IA10.F3.2 Access and use a range of relevant information, material, and human resources with limited direction.	IA11.F3.2 Acquire and use a range of relevant information, material, and human resources, and recognize when additional resources are required.	IA12.F3.2 Support and enhance basic information requirements by using a wide variety of information, material, and human resources.

Personal Skills

General Learning Outcome

GLO P1 **Time Management:** Demonstrate responsibility in time management, task completion, and in meeting project criteria. (Note: based on the Conference Board of Canada's Personal Management Skills)

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P1.1 Demonstrate responsibility in time management.	IA10.P1.1 Demonstrate responsibility in time management.	IA11.P1.1 Demonstrate responsibility in time management.	IA12.P1.1 Demonstrate responsibility in time management.
IA9.P1.2 Demonstrate responsibility in being accountable for one's actions.	IA10.P1.2 Demonstrate responsibility in being accountable for one's actions.	IA11.P1.2 Demonstrate responsibility in being accountable for one's actions.	IA12.P1.2 Demonstrate responsibility in being accountable for one's actions.
IA9.P1.3 Arrive at class prepared with materials and completed assignments.	IA10.P1.3 Arrive at class prepared with materials and completed assignments.	IA11.P1.3 Arrive at class prepared with materials and completed assignments.	IA12.P1.3 Arrive at class prepared with materials and completed assignments.
IA9.P1.4 Complete all assigned tasks within stated deadlines.	IA10.P1.4 Complete all assigned tasks within stated deadlines.	IA11.P1.4 Complete all assigned tasks within stated deadlines.	IA12.P1.4 Complete all assigned tasks within stated deadlines.
IA9.P1.5 Complete all projects according to specified criteria.	IA10.P1.5 Complete all projects according to specified criteria.	IA11.P1.5 Complete all projects according to specified criteria.	IA12.P1.5 Complete all projects according to specified criteria.

Personal Skills

General Learning Outcome

GLO P2 **Ethical Decision Making:** Make ethical decisions concerning the impact of one's activities and the use of technology.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P2.1 Make personal judgments whether certain behaviours/actions are right or wrong.	IA10.P2.1 Assess how personal judgments affect peer members and/or community members.	IA11.P2.1 Assess the implications of personal/group actions within the broader community.	IA12.P2.1 Analyze the implications of personal/group actions within the global context.
IA9.P2.2 Demonstrate an understanding of technological impact on the environment, society, lifestyles, etc.	IA10.P2.2 Demonstrate an understanding of the impact of technological choices.	IA11.P2.2 Develop and implement risk management strategies for a variety of technological activities.	IA12.P2.2 State and support a personal code of ethics as required.
			IA12.P2.3 Demonstrate responsible leadership in managing current and future technologies on the environment and on society.

Personal Skills

General Learning Outcome

GLO P3 **Career Planning:** Develop an action plan relating personal aptitudes and abilities to occupational opportunities.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P3.1 Identify critical skills needed for employability in today's workplace.	IA10.P3.1 Evaluate employability profiles for a variety of workplaces and careers.	IA11.P3.1 Develop strategies to assess personal technological literacy and capability.	IA12.P3.1 Assess specific personal skills, interests, and abilities (career portfolio).
IA9.P3.2 Demonstrate an awareness of the technologies of specific occupations and workplaces.	IA10.P3.2 Outline skills required for a specific career path.	IA11.P3.2 Perform an assessment of personal strengths and weaknesses (career portfolio).	IA12.P3.2 Develop a plan for acquiring the technological capabilities required to achieve a career vision (career portfolio).

Personal Skills

General Learning Outcome

GLO P4 **Safe Practices:** Demonstrate safe practices with tools, machines, materials, and related processes. (Refer to: Keeping Your Facilities SAFE: A Support Document for Industrial Arts Teachers, Manitoba Education and Youth, 2003.)

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P4.1 Follow personal and environmental health and safety procedures.	IA10.P4.1 Recognize and follow personal and environmental health and safety procedures.	IA11.P4.1 Establish and follow personal and environmental health and safety procedures.	IA12.P4.1 Transfer and apply personal and environmental health and safety procedures to a variety of environments and situations.
IA9.P4.2 Identify immediate hazards and their impact on self, others, and the environment.	IA10.P4.2 Identify immediate and potential hazards and their impact on self, others, and the environment.	IA11.P4.2 Identify immediate and potential hazards and assess their impact on self, others, and the environment.	IA12.P4.2 Identify immediate and potential hazards and assess their impact on self, others, and the environment, and recommend safe procedures.
IA9.P4.3 Identify and follow appropriate emergency response procedures.	IA10.P4.3 Identify and follow appropriate emergency response procedures.	IA11.P4.3 Identify and follow appropriate emergency response procedures.	IA12.P4.3 Identify and follow appropriate emergency response procedures.

Personal Skills

General Learning Outcome

GLO P5 **Positive Attitude:** Demonstrate positive attitudes to learning in Industrial Arts facilities.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P5.1 Listen, in order to understand and learn.	IA10.P5.1 Listen and respond, in order to understand and learn.	IA11.P5.1 Listen and respond, in order to understand, learn and teach.	IA12.P5.1 Listen and respond, in order to understand, learn, teach, and evaluate.
IA9.P5.2 Demonstrate a willingness to continuously learn.	IA10.P5.2 Assess personal learning needs (i.e., personal learning style).	IA11.P5.2 Identify learning sources and opportunities.	IA12.P5.2 Set learning goals and develop a personal learning plan.
IA9.P5.3 Actively participate in a positive manner.	IA10.P5.3 Actively participate in a positive manner.	IA11.P5.3 Actively participate in a positive manner.	IA12.P5.3 Actively participate in a positive manner.

Personal Skills

General Learning Outcome

GLO P6 **Teamwork:** Adapt strategies to work effectively, independently, or as a team member to complete a project.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P6.1 Demonstrate an understanding of the role of members of a team.	IA10.P6.1 Contribute to a team to achieve its mandate.	IA11.P6.1 Identify the need to lead and/or support in a team situation, in order to achieve the team mandate.	IA12.P6.1 Understand and work with others on a "job" to achieve the best results.
IA9.P6.2 Acknowledge the opinions and contributions of all team members.	IA10.P6.2 Respect the opinions and contributions of all team members.	IA11.P6.2 Seek and appreciate the opinions and contributions of all team members.	IA12.P6.2 Lead and/or support as appropriate to motivate a team for high performance.
IA9.P6.3 List and define team objectives.	IA10.P6.3 Contribute to the development of team objectives and goals.	IA11.P6.3 →	IA12.P6.3 Develop and/or refine a team approach based on needs and benefits.

Production Skills

General Learning Outcome

GLO MW1 **Metalurgy:** Demonstrate an understanding of metallurgy—science and processes.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.MW1.1 Identify common metals and their classification.	IA10.MW1.1 →	IA11.MW1.1 →	IA12.MW1.1 Select metal for projects and applications based on its physical and mechanical properties.
IA9.MW1.2 Interpret the SAE and AISI coding systems of metal	IA10.MW1.2 →	IA11.MW1.2 →	IA12.MW1.2 →
IA9.MW1.3 Describe a variety of common heat-treating processes including annealing, hardening, tempering, normalizing, case hardening, flame hardening, induction hardening, and laser hardening.	IA10.MW1.3 →	IA11.MW1.3 →	IA12.MW1.3 Apply appropriate hardening processes based on project requirements.
IA9.MW1.4 Explain the powder-metal process and advantages.	IA10.MW1.4 →	IA11.MW1.4 →	IA12.MW1.4 Devise appropriate uses for the powder-metal process.

Production Skills

General Learning Outcome

GLO MW2 **Measurement and Layout:** Use metalworking measurement and layout tools correctly and efficiently.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.MW2.1 Recognize and apply common measurement standards used in metalworking, including CSA, ANSI, ISO, metric, imperial…	IA10.MW2.1 →	IA11.MW2.1 →	IA12.MW2.1 →
IA9.MW2.2 Identify and use several common measurement tools used in metalworking, including rules, micrometers, dial indicators, gauges…	IA10.MW2.2 →	IA11.MW2.2 →	IA12.MW2.2 Identify and use most common measurement tools used in metalworking, including rules, micrometers, dial indicators, gauges…
IA9.MW2.3 Identify and use several common layout tools used in metalworking, including callipers, dividers, squares…	IA10.MW2.3 →	IA11.MW2.3 →	IA12.MW2.3 Apply appropriate layout techniques to the creation of a metalwork project.

Production Skills

General Learning Outcome

GLO MW2 **Separation:** Apply separation processes to metal.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.MW3.1 Identify several common metal separation processes such as cutting, drilling, grinding, turning, milling, and the use of electrical arc and gas torch…	IA10.MW3.1 →	IA11.MW3.1 →	IA12.MW3.1 Explain and demonstrate most common metal separation processes.
IA9.MW3.2 Apply several sheet and bench metal separation processes to a metal product.	IA10.MW3.2 Apply several common machine, gas torch, and electrical arc separation processes to a metal product.	IA11.MW3.2 →	IA12.MW3.2 Determine and apply the appropriate metal separation processes required to safely create a metal product.

Production Skills

General Learning Outcome

GLO MW4 **Fastening:** Apply fastening processes to metal.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.MW4.1 Identify several common metal fastening processes such as using threaded fasteners, riveting, welding, gas torch fastening, electric arc fastening...	IA10.MW4.1 →	IA11.MW4.1 →	IA12.MW4.1 Explain and demonstrate most common metal fastening processes.
IA9.MW4.2 Apply several mechanical, common gas torch and electrical arc metal fastening processes to a metal product.	IA10.MW4.2 →	IA11.MW4.2 →	IA12.MW4.2 Determine and apply the appropriate metal fastening processes required to safely create a metal product.

Production Skills

General Learning Outcome

GLO MW5 **Forming and Casting:** Apply forming and casting processes to metal.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.MW5.1 Identify several common metal forming and casting processes such as sheet metal forming, wrought-iron forming, forging, foundry...	IA10.MW5.1 →	IA11.MW5.1 →	IA12.MW5.1 Explain and demonstrate most common metal-forming processes.
IA9.MW5.2 Apply several mechanical-forming processes to a metal product.	IA10.MW5.2 →	IA11.MW5.2 →	IA12.MW5.2 Determine and apply the appropriate metal-forming processes required to safely create a metal product.

Production Skills

General Learning Outcome

GLO MW6 **Finishing:** Apply finishing processes to metal considering their environmental impact.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.MW6.1 Identify several common metal-finishing processes such as painting, peening, plating, polishing...	IA10.MW6.1 →	IA11.MW6.1 →	IA12.MW6.1 Explain and demonstrate most common metal-finishing processes.
IA9.MW6.2 Apply several common metal-finishing processes to a metal product.	IA10.MW6.2 →	IA11.MW6.2 →	IA12.MW6.2 Determine and apply the appropriate finish to a metal product.
IA9.MW6.3 Explain the environmental impact of most common metal-finishing processes.	IA10.MW6.3 →	IA11.MW6.3 →	IA12.MW6.3 →

Production Skills

General Learning Outcome

GLO MW7 **Current Innovation:** Demonstrate an understanding of current innovation in metalwork processes, applications, and emerging new technologies.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.MW7.1 Identify several current innovations in metalworking such as Computer Numerical Control, jewellery fabrication…	IA10.MW7.1 →	IA11.MW7.1 →	IA12.MW7.1 Research, explain, and demonstrate several current innovations in metalworking.

SENIOR YEARS

Power Mechanics Technology

Fundamental Skills

General Learning Outcome

GLO F1 **Technical Communication:** Communicate technical ideas and designs effectively and appropriately.

Grade 9 Specific Learning Outcome(s)	Grade 10 Specific Learning Outcome(s)	Grade 11 Specific Learning Outcome(s)	Grade 12 Specific Learning Outcome(s)
IA9.F1.1 Use several presentation programs using existing formats to digitally communicate a technical idea.	IA10.F1.1 Design a simple presentation using a presentation program to communicate a technical idea.	IA11.F1.1 Apply an advanced presentation program effectively to communicate a technical idea visually.	IA12.F1.1 Apply an appropriate combination of digital, graphic, oral, and written techniques to effectively communicate a technical idea.
IA9.F1.2 Interpret a graphic presentation of a technical idea.	IA10.F1.2 Adapt a graphic presentation of a technical idea.	IA11.F1.2 Create a graphic presentation of a technical idea.	
IA9.F1.3 Recognize technical language and terms.	IA10.F1.3 Use technical language and terms in the correct context.	IA11.F1.3 Create a set of steps using correct technical writing techniques to effectively describe a technical process.	
IA9.F1.4 Effectively use technical reading skills to follow a set of instructional steps.	IA10.F1.4 Adapt a set of instructional steps using appropriate technical writing skills.		

Fundamental Skills

General Learning Outcome

GLO F2 **Problem Solving:** Apply effective decision-making, problem-solving, and design strategies to a project. (Refer to Appendix B for a sample design/problem-solving process.)

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.F2.1 Demonstrate an understanding of the problem-solving process in designing and producing a product.	IA10.F2.1 Identify problems and apply appropriate problem-solving skills to solve them.	IA11.F2.1 Transfer problem-solving skills to real-life situations.	IA12.F2.1 Research and articulate a problem that can be solved through technological means.
IA9.F2.2 Identify criteria for making and evaluating choices.	IA10.F2.2 Apply a decision-making strategy to practical situations.	IA11.F2.2 Use a variety of critical thinking skills to evaluate situations and make decisions.	IA12.F2.2 Apply problem-solving and design skills to develop a technological solution to a problem.
IA9.F2.3 Demonstrate an understanding of the qualities of good design.	IA10.F2.3 Modify an existing design to meet specified criteria.	IA11.F2.3 Create a design to meet a set of specifications.	IA12.F2.3 Analyze critically and act logically to evaluate situations and make decisions.

Fundamental Skills

General Learning Outcome

GLO F3 **Information Management:** Effectively manage information.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.F3.1 Acquire and organize information using appropriate technology and information systems.	IA10.F3.1 Apply specialized information and skills in real-life situations.	IA11.F3.1 Transfer and apply specialized information and skills in a variety of situations.	IA12.F3.1 Acquire, analyze, and apply specialized information and skills from various disciplines in a variety of realistic circumstances.
IA9.F3.2 Demonstrate the appropriate use of information as directed.	IA10.F3.2 Access and use a range of relevant information, material, and human resources with limited direction.	IA11.F3.2 Acquire and use a range of relevant information, material, and human resources, and recognize when additional resources are required.	IA12.F3.2 Support and enhance basic information requirements by using a wide variety of information, material, and human resources.

Personal Skills

General Learning Outcome

GLO P1 **Time Management:** Demonstrate responsibility in time management, task completion, and in meeting project criteria. (Note: based on the Conference Board of Canada's Personal Management Skills)

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P1.1 Demonstrate responsibility in time management.	IA10.P1.1 Demonstrate responsibility in time management.	IA11.P1.1 Demonstrate responsibility in time management.	IA12.P1.1 Demonstrate responsibility in time management.
IA9.P1.2 Demonstrate responsibility in being accountable for one's actions.	IA10.P1.2 Demonstrate responsibility in being accountable for one's actions.	IA11.P1.2 Demonstrate responsibility in being accountable for one's actions.	IA12.P1.2 Demonstrate responsibility in being accountable for one's actions.
IA9.P1.3 Arrive at class prepared with materials and completed assignments.	IA10.P1.3 Arrive at class prepared with materials and completed assignments.	IA11.P1.3 Arrive at class prepared with materials and completed assignments.	IA12.P1.3 Arrive at class prepared with materials and completed assignments.
IA9.P1.4 Complete all assigned tasks within stated deadlines.	IA10.P1.4 Complete all assigned tasks within stated deadlines.	IA11.P1.4 Complete all assigned tasks within stated deadlines.	IA12.P1.4 Complete all assigned tasks within stated deadlines.
IA9.P1.5 Complete all projects according to specified criteria.	IA10.P1.5 Complete all projects according to specified criteria.	IA11.P1.5 Complete all projects according to specified criteria.	IA12.P1.5 Complete all projects according to specified criteria.

Personal Skills

General Learning Outcome

GLO P2 **Ethical Decision Making:** Make ethical decisions concerning the impact of one's activities and the use of technology.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P2.1 Make personal judgments whether certain behaviours/actions are right or wrong.	IA10.P2.1 Assess how personal judgments affect peer members and/or community members.	IA11.P2.1 Assess the implications of personal/group actions within the broader community.	IA12.P2.1 Analyze the implications of personal/group actions within the global context.
IA9.P2.2 Demonstrate an understanding of technological impact on the environment, society, lifestyles, etc.	IA10.P2.2 Demonstrate an understanding of the impact of technological choices.	IA11.P2.2 Develop and implement risk-management strategies for a variety of technological activities.	IA12.P2.2 State and support a personal code of ethics as required.
			IA12.P2.3 Demonstrate responsible leadership in managing current and future technologies on the environment and on society.

Personal Skills

General Learning Outcome

GLO P3 **Career Planning:** Develop an action plan relating personal aptitudes and abilities to occupational opportunities.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P3.1 Identify critical skills needed for employability in today's workplace.	IA10.P3.1 Evaluate employability profiles for a variety of workplaces and careers.	IA11.P3.1 Develop strategies to assess personal technological literacy and capability.	IA12.P3.1 Assess specific personal skills, interests, and abilities (career portfolio).
IA9.P3.2 Demonstrate an awareness of the technologies of specific occupations and workplaces.	IA10.P3.2 Outline skills required for a specific career path.	IA11.P3.2 Perform an assessment of personal strengths and weaknesses (career portfolio).	IA12.P3.2 Develop a plan for acquiring the technological capabilities required to achieve a career vision (career portfolio).

Personal Skills

General Learning Outcome

GLO P4 **Safe Practices:** Demonstrate safe practices with tools, machines, materials, and related processes. (Refer to: Keeping Your Facilities SAFE: A Support Document for Industrial Arts Teachers, Manitoba Education and Youth, 2003.)

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P4.1 Follow personal and environmental health and safety procedures.	IA10.P4.1 Recognize and follow personal and environmental health and safety procedures.	IA11.P4.1 Establish and follow personal and environmental health and safety procedures.	IA12.P4.1 Transfer and apply personal and environmental health and safety procedures to a variety of environments and situations.
IA9.P4.2 Identify immediate hazards and their impact on self, others, and the environment.	IA10.P4.2 Identify immediate and potential hazards and their impact on self, others, and the environment.	IA11.P4.2 Identify immediate and potential hazards and assess their impact on self, others, and the environment.	IA12.P4.2 Identify immediate and potential hazards and assess their impact on self, others, and the environment, and recommend safe procedures.
IA9.P4.3 Identify and follow appropriate emergency response procedures.	IA10.P4.3 Identify and follow appropriate emergency response procedures.	IA11.P4.3 Identify and follow appropriate emergency response procedures.	IA12.P4.3 Identify and follow appropriate emergency response procedures.

Personal Skills

General Learning Outcome

GLO P5 **Positive Attitude:** Demonstrate positive attitudes to learning in Industrial Arts facilities.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P5.1 Listen, in order to understand and learn.	IA10.P5.1 Listen and respond, in order to understand and learn.	IA11.P5.1 Listen and respond, in order to understand, learn and teach.	IA12.P5.1 Listen and respond, in order to understand, learn, teach, and evaluate.
IA9.P5.2 Demonstrate a willingness to continuously learn.	IA10.P5.2 Assess personal learning needs (i.e., personal learning style).	IA11.P5.2 Identify learning sources and opportunities.	IA12.P5.2 Set learning goals and develop a personal learning plan.
IA9.P5.3 Actively participate in a positive manner.	IA10.P5.3 Actively participate in a positive manner.	IA11.P5.3 Actively participate in a positive manner.	IA12.P5.3 Actively participate in a positive manner.

Personal Skills

General Learning Outcome

GLO P6 **Teamwork:** Adapt strategies to work effectively, independently, or as a team member to complete a project.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P6.1 Demonstrate an understanding of the role of members of a team.	IA10.P6.1 Contribute to a team to achieve its mandate.	IA11.P6.1 Identify the need to lead and/or support in a team situation, in order to achieve the team mandate.	IA12.P6.1 Understand and work with others on a "job" to achieve the best results.
IA9.P6.2 Acknowledge the opinions and contributions of all team members.	IA10.P6.2 Respect the opinions and contributions of all team members.	IA11.P6.2 Seek and appreciate the opinions and contributions of all team members.	IA12.P6.2 Lead and/or support as appropriate to motivate a team for high performance.
IA9.P6.3 List and define team objectives.	IA10.P6.3 Contribute to the development of team objectives and goals.		IA12.P6.3 Develop and/or refine a team approach based on needs and benefits.

Production Skills

General Learning Outcome

GLO PM1 **Energy Conversion:** Demonstrate an understanding of the theory of internal combustion and alternate energy converters.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.PM1.1 Identify several methods of converting fuel to mechanical energy such as internal combustion, hydrogen fuel cell, diesel engines (glow plug .049 model)…	IA10.PM1.1 →	IA11.PM1.1 →	IA12.PM1.1 Explain and demonstrate the principles behind several methods of converting fuel to mechanical energy.
IA9.PM1.2 Identify several types and applications of internal combustion engines such as two-stroke, four-stroke, rotary, diesel, K-cycle…	IA10.PM1.2 →	IA11.PM1.2 →	IA12.PM1.2 Explain and demonstrate in detail the operation and cycles of most types of internal combustion engines.
IA9.PM1.3 Identify the basic parts of several types of internal combustion engines.	IA10.PM1.3 →	IA11.PM1.3 →	IA12.PM1.3 Disassemble, identify, and explain the operation of the basic parts of most internal combustion engines.

Production Skills

General Learning Outcome

GLO PM2 **Engine Systems:** Identify and analyze various engine systems.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.PM2.1 Identify the parts of the fuel and engine management system in an internal combustion engine such as the fuel injector, throttle, fuel pressure regulator, idle air control valve...	IA10.PM2.1 →	IA11.PM2.1 →	IA12.PM2.1 Identify, explain the operation and function of, and adjust/repair (when possible) the parts of the fuel management system in an internal combustion engine.
IA9.PM2.2 Identify the parts of the filtering system in an internal combustion engine such as the engine air filter, oil filter, automatic transmission filter...	IA10.PM2.2 →	IA11.PM2.2 →	IA12.PM2.2 Identify, explain the operation of and clean/replace the parts of the filtering system of an internal combustion engine.
IA9.PM2.3 Identify the parts of the cooling system in an internal combustion engine such as the radiator, fan, shroud, water pump...	IA10.PM2.3 →	IA11.PM2.3 →	IA12.PM2.3 Identify, explain, and adjust/repair (when possible) the parts of the cooling system of an internal combustion engine.
IA9.PM2.4 Identify the parts of the exhaust and emissions system of an internal combustion engine such as the EGR valve, catalytic converter, muffler…	IA10.PM2.4 →	IA11.PM2.4 →	IA12.PM2.4 Identify, explain, and adjust/repair (when possible) the parts of the exhaust and emissions system of an internal combustion engine.

Production Skills

General Learning Outcome

GLO PM3 **Electrical Systems:** Understand the basic electrical principles applied to power mechanics systems.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.PM3.1 Identify the parts of the wiring system in an internal combustion engine such as the circuit protection devices, wire harness…	IA10.PM3.1 →	IA11.PM3.1 →	IA12.PM3.1 Identify, explain the operation and function of, and adjust/repair (when possible) the parts of the wiring system in an internal combustion engine.
IA9.PM3.2 Identify the parts of the starting system in an internal combustion engine such as the starter motor, starter solenoid…	IA10.PM3.2 →	IA11.PM3.2 →	IA12.PM3.2 Identify, explain the operation and function of, and adjust/repair (when possible) the parts of the starting system in an internal combustion engine.
IA9.PM3.3 Identify the parts of the charging system in an internal combustion engine such as the alternator, battery…	IA10.PM3.3 →	IA11.PM3.3 →	IA12.PM3.3 Identify, explain the operation and function of, and adjust/repair (when possible) the parts of the charging system in an internal combustion engine.

Production Skills

General Learning Outcome

GLO PM4 **Mechanical Systems:** Identify and analyze the mechanical systems of an internal combustion engine.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.PM4.1 Identify the parts of the transmission system in an internal combustion engine such as the torque converter, input shaft, planetary gear sets…	IA10.PM4.1 →	IA11.PM4.1 →	IA12.PM4.1 Identify, explain the operation and function of, and adjust/repair (when possible) the parts of the transmission system in an internal combustion engine.
IA9.PM4.2 Identify the parts of the power train system in an internal combustion engine such as the camshaft, driveshaft, differential, PCM module…	IA10.PM4.2 →	IA11.PM4.2 →	IA12.PM4.2 Identify, explain the operation and function of, and adjust/repair (when possible) the parts of the power train system in an internal combustion engine.

Production Skills

General Learning Outcome

GLO PM5 **Chassis Systems:** Identify and compare various automotive chassis systems.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.PM5.1 Identify the parts of the brake system of an automobile such as the brake drums, brake lines, master cylinder, ABS modulator…	IA10.PM5.1 →	IA11.PM5.1 →	IA12.PM5.1 Identify, explain the operation and function of, and adjust/repair (when possible) the parts of the brake system in an automobile.
IA9.PM5.2 Identify the parts of the ride and handling system of an automobile such as the shock absorbers, stabilizer bar, Macpherson struts…	IA10.PM5.2 →	IA11.PM5.2 →	IA12.PM5.2 Identify, explain the operation and function of, and adjust/repair (when possible) the parts of the ride and handling system in an automobile.
IA9.PM5.3 Identify the parts of the steering system of an automobile such as the power-steering pump, tie-rod ends, pitman arm…	IA10.PM5.3 →	IA11.PM5.3 →	IA12.PM5.3 Identify, explain the operation and function of, and adjust/repair (when possible) the parts of the steering system in an automobile.

Production Skills

General Learning Outcome

GLO PM6 **Climate Control Systems:** Identify and analyze the climate control systems in an automobile.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.PM6.1 Identify the parts of the heating system of an automobile such as the heater core, blower motor, hoses…	IA10.PM6.1 →	IA11.PM6.1 →	IA12.PM6.1 Identify, explain the operation and function of, and adjust/repair (when possible) the parts of the heating system in an automobile.
IA9.PM6.2 Identify the parts of the air-conditioning system of an automobile such as the condenser, compressor, evaporator…	IA10.PM6.2 →	IA11.PM6.2 →	IA12.PM6.2 Identify, explain the operation and function of, and adjust/repair (when possible) the parts of the air-conditioning system in an automobile.

Production Skills

General Learning Outcome

GLO PM7 **Assembly/Disassembly Tools:** Demonstrate the use of tools and equipment in assembly and disassembly of mechanical components.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.PM7.1 Identify and use tools common to power mechanics such as hand tools, power tools, hoists, jacks…	IA10.PM7.1 →	IA11.PM7.1 →	IA12.PM7.1 Determine and apply the appropriate tool for a given power mechanics task.
IA9.PM7.2 Identify and use common reconditioning tools used in power mechanics such as lathes, wire wheels, seat grinde…	IA10.PM7.2 →	IA11.PM7.2 →	IA12.PM7.2 Determine and apply the appropriate tool for a given engine reconditioning task.
IA9.PM7.3 Identify common fasteners used on automobiles such as bolts, rivets, pins…	IA10.PM7.3 →	IA11.PM7.3 →	IA12.PM7.3 Determine and apply the appropriate fastener for a given task.
IA9.PM7.4 Identify tools and materials used with seals in automobiles such as gasket rubber, gasket felt, silicon seal, glues…	IA10.PM7.4 →	IA11.PM7.4 →	IA12.PM7.4 Determine and apply the appropriate seal, gasket, and/or adhesive for a given sealing task.
IA9.PM7.5 Identify the manuals and manual systems used in automobile repair.	IA10.PM7.5 →	IA11.PM7.5 →	IA12.PM7.5 Use an automotive manual to obtain repair information.

Production Skills

General Learning Outcome

GLO PM8 **Diagnostic Tools:** Use diagnostic tools and methods to troubleshoot, diagnose, and repair power mechanical systems.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.PM8.1 Identify common automotive diagnostic tools such as ignition testers, charging system analyzers, scopes, scanners…	IA10.PM8.1 →	IA11.PM8.1 →	IA12.PM8.1 Use appropriate diagnostic tools and problem-solving methods to analyze and repair automotive issues.
IA9.PM8.2 Explain common automotive diagnostic techniques such as the spark test, compression test, fuel delivery test, ignition timing…	IA10.PM8.2 →	IA11.PM8.2 →	IA12.PM8.2 Use appropriate diagnostic techniques and problem-solving methods to analyze and repair automotive issues.

Production Skills

General Learning Outcome

GLO PM9 **Environmental Impact and Current Innovations:** Demonstrate an understanding of current innovation in automotive industry, environmental impacts, and emerging new technologies.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.PM9.1 Identify several current innovations in the automotive industry such as continuously variable transmissions, advanced suspension systems, modular vehicle assembly, use of new materials…	IA10.PM9.1 →	IA11.PM9.1 →	IA12.PM9.1 Research, explain, and demonstrate several current innovations in the automotive industry.
IA9.PM9.2 Identify several current issues and innovations regarding the automotive industry and environmental impact such as emission issues, energy consumption, sustainable development…	IA10.PM9.2 →	IA11.PM9.2 →	IA12.PM9.2 Research, explain, and demonstrate several current issues and innovations regarding the automotive industry and environmental impact.

SENIOR YEARS

Woodwork Technology

Fundamental Skills

General Learning Outcome

GLO F1 **Technical Communication:** Communicate technical ideas and designs effectively and appropriately.

Grade 9 Specific Learning Outcome(s)	Grade 10 Specific Learning Outcome(s)	Grade 11 Specific Learning Outcome(s)	Grade 12 Specific Learning Outcome(s)
IA9.F1.1 Use several presentation programs using existing formats to digitally communicate a technical idea.	IA10.F1.1 Design a simple presentation using a presentation program to communicate a technical idea.	IA11.F1.1 Apply an advanced presentation program effectively to communicate a technical idea visually.	IA12.F1.1 Apply an appropriate combination of digital, graphic, oral, and written techniques to effectively communicate a technical idea.
IA9.F1.2 Interpret a graphic presentation of a technical idea.	IA10.F1.2 Adapt a graphic presentation of a technical idea.	IA11.F1.2 Create a graphic presentation of a technical idea.	
IA9.F1.3 Recognize technical language and terms.	IA10.F1.3 Use technical language and terms in the correct context.	IA11.F1.3 Create a set of steps using correct technical writing techniques to effectively describe a technical process.	
IA9.F1.4 Effectively use technical reading skills to follow a set of instructional steps.	IA10.F1.4 Adapt a set of instructional steps using appropriate technical writing skills.		

Fundamental Skills

General Learning Outcome

GLO F2 **Problem Solving:** Apply effective decision-making, problem-solving, and design strategies to a project. (Refer to Appendix B for a sample design/problem-solving process.)

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.F2.1 Demonstrate an understanding of the problem-solving process in designing and producing a product.	IA10.F2.1 Identify problems and apply appropriate problem-solving skills to solve them.	IA11.F2.1 Transfer problem-solving skills to real-life situations.	IA12.F2.1 Research and articulate a problem that can be solved through technological means.
IA9.F2.2 Identify criteria for making and evaluating choices.	IA10.F2.2 Apply a decision-making strategy to practical situations.	IA11.F2.2 Use a variety of critical thinking skills to evaluate situations and make decisions.	IA12.F2.2 Apply problem-solving and design skills to develop a technological solution to a problem.
IA9.F2.3 Demonstrate an understanding of the qualities of good design.	IA10.F2.3 Modify an existing design to meet specified criteria.	IA11.F2.3 Create a design to meet a set of specifications.	IA12.F2.3 Analyze critically and act logically to evaluate situations and make decisions.

Fundamental Skills

General Learning Outcome

GLO F3 **Information Management:** Effectively manage information.

Grade 9 Specific Learning Outcome(s)	Grade 10 Specific Learning Outcome(s)	Grade 11 Specific Learning Outcome(s)	Grade 12 Specific Learning Outcome(s)
IA9.F3.1 Acquire and organize information using appropriate technology and information systems.	IA10.F3.1 Apply specialized information and skills in real-life situations.	IA11.F3.1 Transfer and apply specialized information and skills in a variety of situations.	IA12.F3.1 Acquire, analyze, and apply specialized information and skills from various disciplines in a variety of realistic circumstances.
IA9.F3.2 Demonstrate the appropriate use of information as directed.	IA10.F3.2 Access and use a range of relevant information, material, and human resources with limited direction.	IA11.F3.2 Acquire and use a range of relevant information, material, and human resources, and recognize when additional resources are required.	IA12.F3.2 Support and enhance basic information requirements by using a wide variety of information, material, and human resources.

Personal Skills

General Learning Outcome

GLO P1 **Time Management:** Demonstrate responsibility in time management, task completion, and in meeting project criteria. (Note: based on the Conference Board of Canada's Personal Management Skills)

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P1.1 Demonstrate responsibility in time management.	IA10.P1.1 Demonstrate responsibility in time management.	IA11.P1.1 Demonstrate responsibility in time management.	IA12.P1.1 Demonstrate responsibility in time management.
IA9.P1.2 Demonstrate responsibility in being accountable for one's actions.	IA10.P1.2 Demonstrate responsibility in being accountable for one's actions.	IA11.P1.2 Demonstrate responsibility in being accountable for one's actions.	IA12.P1.2 Demonstrate responsibility in being accountable for one's actions.
IA9.P1.3 Arrive at class prepared with materials and completed assignments.	IA10.P1.3 Arrive at class prepared with materials and completed assignments.	IA11.P1.3 Arrive at class prepared with materials and completed assignments.	IA12.P1.3 Arrive at class prepared with materials and completed assignments.
IA9.P1.4 Complete all assigned tasks within stated deadlines.	IA10.P1.4 Complete all assigned tasks within stated deadlines.	IA11.P1.4 Complete all assigned tasks within stated deadlines.	IA12.P1.4 Complete all assigned tasks within stated deadlines.
IA9.P1.5 Complete all projects according to specified criteria.	IA10.P1.5 Complete all projects according to specified criteria.	IA11.P1.5 Complete all projects according to specified criteria.	IA12.P1.5 Complete all projects according to specified criteria.

Personal Skills

General Learning Outcome

GLO P2 **Ethical Dicision Making:** Make ethical decisions concerning the impact of one's activities and the use of technology.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P2.1 Make personal judgments whether certain behaviours/actions are right or wrong.	IA10.P2.1 Assess how personal judgments affect peer members and/or community members.	IA11.P2.1 Assess the implications of personal/group actions within the broader community.	IA12.P2.1 Analyze the implications of personal/group actions within the global context.
IA9.P2.2 Demonstrate an understanding of technological impact on the environment, society, lifestyles, etc.	IA10.P2.2 Demonstrate an understanding of the impact of technological choices.	IA11.P2.2 Develop and implement risk management strategies for a variety of technological activities.	IA12.P2.2 State and support a personal code of ethics as required.
			IA12.P2.3 Demonstrate responsible leadership in managing current and future technologies on the environment and on society.

Personal Skills

General Learning Outcome

GLO P3 **Career Planning:** Develop an action plan relating personal aptitudes and abilities to occupational opportunities.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P3.1 Identify critical skills needed for employability in today's workplace.	IA10.P3.1 Evaluate employability profiles for a variety of workplaces and careers.	IA11.P3.1 Develop strategies to assess personal technological literacy and capability.	IA12.P3.1 Assess specific personal skills, interests, and abilities (career portfolio).
IA9.P3.2 Demonstrate an awareness of the technologies of specific occupations and workplaces.	IA10.P3.2 Outline skills required for a specific career path.	IA11.P3.2 Perform an assessment of personal strengths and weaknesses (career portfolio).	IA12.P3.2 Develop a plan for acquiring the technological capabilities required to achieve a career vision (career portfolio).

Personal Skills

General Learning Outcome

GLO P4 **Safe Practices:** Demonstrate safe practices with tools, machines, materials, and related processes. (Refer to: Keeping Your Facilities SAFE: A Support Document for Industrial Arts Teachers, Manitoba Education and Youth, 2003.)

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P4.1 Follow personal and environmental health and safety procedures.	IA10.P4.1 Recognize and follow personal and environmental health and safety procedures.	IA11.P4.1 Establish and follow personal and environmental health and safety procedures.	IA12.P4.1 Transfer and apply personal and environmental health and safety procedures to a variety of environments and situations.
IA9.P4.2 Identify immediate hazards and their impact on self, others, and the environment.	IA10.P4.2 Identify immediate and potential hazards and their impact on self, others, and the environment.	IA11.P4.2 Identify immediate and potential hazards and assess their impact on self, others, and the environment.	IA12.P4.2 Identify immediate and potential hazards and assess their impact on self, others, and the environment, and recommend safe procedures.
IA9.P4.3 Identify and follow appropriate emergency response procedures.	IA10.P4.3 Identify and follow appropriate emergency response procedures.	IA11.P4.3 Identify and follow appropriate emergency response procedures.	IA12.P4.3 Identify and follow appropriate emergency response procedures.

Personal Skills

General Learning Outcome

GLO P5 **Positive Attitude:** Demonstrate positive attitudes to learning in Industrial Arts facilities.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P5.1 Listen, in order to understand and learn.	IA10.P5.1 Listen and respond, in order to understand and learn.	IA11.P5.1 Listen and respond, in order to understand, learn and teach.	IA12.P5.1 Listen and respond, in order to understand, learn, teach, and evaluate.
IA9.P5.2 Demonstrate a willingness to continuously learn.	IA10.P5.2 Assess personal learning needs (i.e., personal learning style).	IA11.P5.2 Identify learning sources and opportunities.	IA12.P5.2 Set learning goals and develop a personal learning plan.
IA9.P5.3 Actively participate in a positive manner.	IA10.P5.3 Actively participate in a positive manner.	IA11.P5.3 Actively participate in a positive manner.	IA12.P5.3 Actively participate in a positive manner.

Personal Skills

General Learning Outcome

GLO P6 **Teamwork:** Adapt strategies to work effectively, independently, or as a team member to complete a project.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P6.1 Demonstrate an understanding of the role of members of a team.	IA10.P6.1 Contribute to a team to achieve its mandate.	IA11.P6.1 Identify the need to lead and/or support in a team situation, in order to achieve the team mandate.	IA12.P6.1 Understand and work with others on a "job" to achieve the best results.
IA9.P6.2 Acknowledge the opinions and contributions of all team members.	IA10.P6.2 Respect the opinions and contributions of all team members.	IA11.P6.2 Seek and appreciate the opinions and contributions of all team members.	IA12.P6.2 Lead and/or support as appropriate to motivate a team for high performance.
IA9.P6.3 List and define team objectives.	IA10.P6.3 Contribute to the development of team objectives and goals.		IA12.P6.3 Develop and/or refine a team approach based on needs and benefits.

Production Skills

General Learning Outcome

GLO WW1 **Wood, Products, and Processes:** Demonstrate an understanding of woodwork—woods, wood products, and processes.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.WW1.1 Identify common woods, their classification as hardwood or softwood, and their properties such as type, species, grain texture…	IA10.WW1.1 →	IA11.WW1.1 →	IA12.WW1.1 Select appropriate wood type, based on its properties for projects and applications.
IA9.WW1.2 Identify several common wood products such as plywoods, laminates, veneers, particleboard…	IA10.WW1.2 →	IA11.WW1.2 →	IA12.WW1.2 Select appropriate wood products based on project requirements.

Production Skills

General Learning Outcome

GLO WW2 **Measurement and Layout:** Use woodworking measurement and layout tools, correctly and efficiently.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.WW2.1 Recognize and apply common measurement standards used in woodworking including CSA, ANSI, ISO, metric, imperial, moisture content…	IA10.WW2.1 →	IA11.WW2.1 →	IA12.WW2.1 →
IA9.WW2.2 Identify and use several common measurement tools used in woodworking including rules, tapes, dividers, wood-moisture meters…	IA10.WW2.2 →	IA11.WW2.2 →	IA12.WW2.2 Identify and use most common measurement tools used in woodworking including rules, tapes, dividers, wood-moisture meters…
IA9.WW2.3 Identify and use several common layout tools used in woodwork including squares, levels, lasers, sliding bevels, marking gauges…	IA10.WW2.3 →	IA11.WW2.3 →	IA12.WW2.3 Apply appropriate layout techniques to the creation of a woodwork project.

Production Skills

General Learning Outcome

GLO WW3 **Separation:** Apply separation processes to wood.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.WW3.1 Identify several common wood-separation processes such as cutting, drilling, turning, routing, sanding…	IA10.WW3.1 →	IA11.WW3.1 →	IA12.WW3.1 Explain and demonstrate most common wood-separation processes.
IA9.WW3.2 Apply several hand tool wood-separation processes to a product.	IA10.WW3.2 →	IA11.WW3.2 →	IA12.WW3.2 Determine and apply the appropriate wood-separation processes required to safely create a wood product.

Production Skills

General Learning Outcome

GLO WW4 **Fastening:** Apply fastening processes and specialty hardware to wood, correctly and effieciently.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.WW4.1 Identify several common wood-fastening processes such as using: threaded fasteners, adhesives, nails, specialty fastening hardware...	IA10.WW4.1 →	IA11.WW4.1 →	IA12.WW4.1 Identify and describe the classification and types of several common wood-fastening processes.
IA9.WW4.2 Apply several fastening processes to a wood product.	IA10.WW4.2 →	IA11.WW4.2 →	IA12.WW4.2 Determine and apply the appropriate wood-fastening processes required to create a wood product.
IA9.WW4.3 Identify several common types of specialty hardware used in creating wood projects such as hinges, glides, pulls, shelf hardware, casters…	IA10.WW4.3 →	IA11.WW4.3 →	IA12.WW4.3 Determine and install the type of specialty hardware required for a project.

Production Skills

General Learning Outcome

GLO WW5 **Wood Joints:** Apply joints and joining techniques to wood.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.WW5.1 Identify several common wood joints such as butt, box, dado, dovetail, lap, mitre, mortise and tenon, rabbet, tongue and groove...	IA10.WW5.1 →	IA11.WW5.1 →	IA12.WW5.1 List the uses and properties of most wood joints.
IA9.WW5.2 Identify several common fastener forms used in wood joints such as corrugated fasteners, dowels, splines, braces, special connectors.	IA10.WW5.2 →	IA11.WW5.2 →	IA12.WW5.2 List the uses and properties of most wood-joining techniques.
IA9.WW5.3 Use several types of wood joints and wood-joining techniques in the fabrication of a wood product.	IA10.WW5.3 →	IA11.WW5.3 →	IA12.WW5.3 Determine and apply the appropriate wood joint and/or wood-joining technique to the fabrication of a wood product.

Production Skills

General Learning Outcome

GLO WW6 **Finishing:** Apply finishing processes to wood considering their environmental impact.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.WW6.1 Identify several common wood-finishing processes such as sanding, staining, painting, varnishing…	IA10.WW6.1 →	IA11.WW6.1 →	IA12.WW6.1 Identify and explain the properties of most common wood-finishing processes.
IA9.WW6.2 Explain the environmental impact of most common wood-finishing processes.	IA10.WW6.2 →	IA11.WW6.2 →	IA12.WW6.2 →
IA9.WW6.3 Apply several common wood-finishing processes to a product.	IA10.WW6.3 →	IA11.WW6.3 →	IA12.WW6.3 Determine and apply the appropriate finish to a wood product.

Production Skills

General Learning Outcome

GLO WW7 **Current Innovation:** Demonstrate an understanding of current innovation in woodwork processes, applications, and emerging new technologies.

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.WW7.1 Identify several current innovations in woodwork such as Computer Numerical Control, strand wood products, glulam products, computer log and lumber analysis, factory-made housing, structural insulated panels…	IA10.WW7.1 →	IA11.WW7.1 →	IA12.WW7.1 Research, explain, and demonstrate several current innovations in woodwork.

SENIOR YEARS

Appendices

Appendix A: Writing Learning Outcomes

What Are the Characteristics of Good Learning Outcomes?

Learning outcomes have three distinguishing characteristics. The specific action by the learner must be

1. observable
2. measurable
3. obtainable

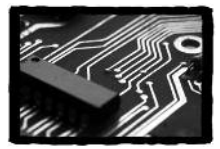
The SLOs help teachers to focus on particular aspects of knowledge and skills as they plan learning activities for their students.

Tips for Rewriting Objectives as Learning Outcomes

- Start with the Grade 12 learning outcomes and proceed to the Grade 11, Grade 10, and then finally the Grade 9 learning outcomes. Use a backward process.
- Compare the learning outcomes in each category with what you are currently doing in the classroom.
- The Specific Learning Outcomes have to support the General Learning Outcome.

Sample Set of Specific Learning Outcomes

General Learning Outcome



GLO P4 **Safe Practices:** Demonstrate safe practices with tools, machines, materials, and related processes. (Refer to: *Keeping Your Facilities SAFE: A Support Document for Industrial Arts Teachers,* Manitoba Education and Youth, 2003.)

Grade 9 Specific Learning Outcome(s)	**Grade 10** Specific Learning Outcome(s)	**Grade 11** Specific Learning Outcome(s)	**Grade 12** Specific Learning Outcome(s)
IA9.P4.1 Follow personal and environmental health and safety procedures.	IA10.P4.1 Recognize and follow personal and environmental health and safety procedures.	IA11.P4.1 Establish and follow personal and environmental health and safety procedures.	IA12.P4.1 Transfer and apply personal and environmental health and safety procedures to a variety of environments and situations.

Verb List for Writing Student Learning Outcomes

Verbal/Linguistic Verbs

Adapt
Address
Amend
Answer
Argue
Articulate
Associate
Compose
Convert
Convince
Create
Critique
Debate
Defend
Define
Demonstrate
Describe
Devise
Discuss
Display
Distinguish
Draft
Elaborate
Embellish
Enrich
Enunciate
Expand
Explain
Express in other terms
Extend
Form
Generalize
Generate
Give examples
Give in own words
Indicate
Inform
Interview
Introduce
Invent
Justify
Label
List
Listen
Make up
Memorize
Modify
Name
Paraphrase
Point out
Predict
Prescribe
Present
Pretend
Produce
Publish
Question
Quote
Read
Recall
Recite
Recognize
Recommend
Redirect
Relate
Repeat
Report
Restate
Respond
Retell
Reword
Rewrite
Revise
Specify
State
Suggest
Summarize
Synthesize
Teach
Tell
Translate
Transmit
Use
Write

Interpersonal Verbs

Advise
Articulate
Assign
Coach
Communicate an opinion
Compose
Contribute
Create
Demonstrate
Design
Discuss
Display
Educate
Empathize
Encounter
Evaluate
Experience
Explain
Give feedback
Identify
Illustrate
Improve
Interpret
Interview
Instruct
Justify
Listen
Motivate
Organize
Perceive
Plan
Play
Practise
Present
Project
Receive feedback
Record
Relate
Role-play
Seek
Share
Show
Solve
Spell out
Teach
Train
Translate
Write

Intrapersonal Verbs

Access
Advocate
Amend
Analyze
Apply
Appraise
Assess
Assimilate
Award
Choose
Communicate an idea
Compare
Contrast
Concentrate
Conclude
Contribute
Create
Critique
Decide
Defend
Demonstrate
Describe
Determine
Discriminate
Draw
Evaluate
Explain
Explore
Focus
Illustrate
Imagine
Interpolate
Interpret
Judge
List

Intrapersonal Verbs (continued)

Make
Narrate
Plan
Point out
Position
Practise
Prepare
Propose
Rank
Rate
Recognize
Recount
Redraw
Reflect
Report
Review
Revise
Rewrite
Select
Self-reflect
Share
Show
Suggest
Support
Tell
Track
Use
Validate
Write

Logical/Mathematical Verbs

Analyze
Appraise
Apply
Arrange
Brainstorm
Break down
Calculate
Cause/Effect
Check
Classify
Combine
Compare
Compute
Conclude
Contrast
Convert
Count
Criticize
Decide
Decipher
Deduce
Demonstrate
Derive
Detect
Determine
Develop
Devise
Differentiate
Discern
Discover
Discriminate
Distinguish
Estimate
Evaluate
Examine
Exercise
Extrapolate
Find examples
Find relationships
Find unknown
Formulate
Grasp
Hypothesize
Infer
Integrate
Interpret
Link
Measure
Modify
Observe
Order
Outline
Plot
Ponder
Predict
Prove
Puzzle

Logical/Mathematical Verbs (continued)

Rank
Resolve
Select
Separate
Sequence
Simplify
Solve
Test
Track
Translate
Unify
Verify

Visual/Spatial Verbs

Build
Cast
Change
Chart
Convert
Compose
Copy
Create
Decorate
Demonstrate
Design
Diagram
Distinguish
Divide
Draw
Elaborate
Embellish
Enlarge
Expand
Form
Formulate
Graph
Identify
Illustrate
Improve
Integrate
Interpret
Invent
Label
List
Make
Mark
Mind map
Model
Organize
Originate
Outline
Produce
Rearrange
Recognize
Render
Reorder
Represent
Reproduce
Show
Sketch
Transform

Body/Kinesthetic Verbs

Act out
Adjust
Apply
Arrange
Bend
Blend
Build
Categorize
Change
Choose
Classify
Collect information
Combine
Compare
Compile

Body/Kinesthetic Verbs (continued)

Complete
Conduct
Construct
Count
Create
Demonstrate
Design
Determine
Develop
Devise
Discover
Display
Divide
Document
Dramatize
Engage
Erect
Examine
Execute
Exercise
Experiment
Fill in
Find
Fold
Form
Fuse
Gauge
Group
Imitate
Inspect
Interpret
Invent
Investigate
Jump
Keep records
Leap
Locate
Make
Make up
Manipulate
Match
Measure
Model
Modify
Move
Operate
Order
Organize
Participate
Perform
Pick
Plan
Point
Post
Practise
Prepare
Present
Produce
Put
Put in order
Put to use
Put together
Rearrange
Reconstruct
Record
Reorder
Reorganize
Restructure
Role-play
Rotate
Search
Select
Separate
Shake
Show
Simulate
Sort
Spin
Spring
Stage
Stand
Stretch
Subdivide
Survey
Tabulate
Take apart
Touch
Trace
Track
Train
Transfer
Turn
Twist
Uncover
Underline
Use
Vault
Write

Musical/Rhythmic Verbs

Amplify
Arrange
Blend
Classify
Compare/Contrast
Compose
Create
Demonstrate
Elevate
Enhance
Explain
Express
Harmonize
Hear
Hum
Illustrate
Incorporate
Interpret
Listen
Make up
Modify
Orchestrate
Perform
Play
Practise
Present
Produce
Represent
Retell
Select
Show
Sing
Stage
Train
Modify
Write about

Appendix B: A Design/Problem-Solving Process

The design/problem-solving process could include the following steps:

1. **Stating the Problem**—demonstrating a need
2. **Developing the Design Brief**—describing what is to be designed, simply and clearly
3. **Investigating**—listing all of the information that may be needed. Some areas of consideration are:
   - Function—a functional object must solve the problem described in the design brief
   - Appearance—the shape, colour, and texture should make the product attractive
   - Materials—availability, cost, and physical properties should all be considered
   - Production—the product should be capable of being efficiently produced
   - Safety—the product should be able to be produced and used safely
4. **Developing Alternative Solutions**
   - considering a number of solutions
   - recording all ideas
5. **Choosing a Solution**
   - selecting the best solution after comparing the solutions to the original design brief
   - giving consideration to the manufacturer's skills, the availability of materials, the time needed to complete, and the final costs
6. **Creating Models and/or Prototypes**
   - creating the first working version of the designer's solution
   - confirming the chosen solution
7. **Testing and Evaluating**—answering these basic questions:
   - Does it work?
   - Does it meet the design brief?
   - Will modification improve the solution?
8. **Starting Production**—making the product once the design is finalized

SENIOR YEARS

References

References

ACDelco—Automotive Systems Guide. Homepage. 2007. <www.acdelco.com/services/index.jsp>. (23 May 2007).

Alberta Education. *Career and Technology Studies.* Edmonton, AB: Alberta Education, 1997.

Atlantic Provinces Education Foundation. *Foundation for the Atlantic Canada Technology Education Curriculum.* Halifax, NS: Atlantic Provinces Education Foundation, 2001.

British Columbia Ministry of Education. *Technology Education 8 to 10, Integrated Resource Package.* Victoria, BC: British Columbia Ministry of Education, 1995.

Conference Board of Canada. *About the Conference Board of Canada.* 2002. <www.conferenceboard.ca/who.htm>

4 Teachers Site. Homepage. <www.4teachers.org>. (24 May 2007).

Human Resources and Social Development Canada (HRSDC). "About Human Resources Development Canada. 2007." <www.hrsdc.gc.ca/en/cs/comm/about_us.shtml> (25 May 2007).

Lazear, David. *Seven Ways of Knowing: Teaching for Multiple Intelligences.* Palatine, IL: IRI/SkyLight Training and Publishing, 1991.

Manitoba Education and Training. *A Foundation for Excellence.* New Directions series. Winnipeg, MB: Manitoba Education and Training, 1995.

---. *Keeping Your Facilities SAFE: A Support Document for Industrial Arts Teachers.* Winnipeg, MB: Manitoba Education and Youth, 2003.

---. *Middle Years Home Economics/Industrial Arts: Linking Learning to Living.* Winnipeg, MB: Manitoba Education and Youth, 2003.

---. *Senior 1 English Language Arts: A Foundation for Implementation.* Winnipeg, MB: Manitoba Education and Training, 1997.

---. *Senior 4 Applied Technology (draft).* Winnipeg, MB: Manitoba Education and Training, 1996.

---. *Success for All Learners: A Handbook on Differentiating Instruction.* Winnipeg, MB: Manitoba Education and Training, 1996.

---. *Subject Table Handbook: Technology Education:* September 2001–June 2002. Winnipeg, MB: Manitoba Education, Training and Youth, 2002.

National Life/Work Centre. *Blueprint for Life/Work Designs.* Memramcook, NB: National Training and Support Centre Memramcook Institute, 2000.

Ontario Ministry of Education. *Curriculum Guideline – Broad Based Technological Education Grades 10, 11, 12.* Toronto, ON: Ontario Ministry of Education, 1995.

Rogers, S. *Teaching Tips: 105 Ways to Increase Motivation and Learning.* Evergreen, CO: Peak Learning Systems, 1999.

Saskatchewan Education. *Instructional Approaches: A Framework for Professional Practice.* Regina, SK: Saskatchewan Education, 1991.

Saskatchewan Learning. *Practical and Applied Arts Handbook.* Regina SK, Saskatchewan Learning, 2002.

Sousa, 0. *How the Brain Learns.* Thousand Oaks, CA: Corwin Press. 1998.

Technology Educators' Association of Manitoba Inc. *Industrial Arts/Technology Education: K to Senior IV Framework Policy.* Winnipeg, MB: Technology Educators' Association of Manitoba Inc., 1998.

---. *Technology Education Association of Manitoba Objectives for an Effective Technology Education Program.* Winnipeg, MB: Technology Educators' Association of Manitoba Inc, 1999. <www.technologyeducators.mb.ca

Technology for All Americans. *Standard for Technological Literacy: Content for the Study of Technology.* Reston, VA: International Technology Education Association, 2000.

Tileston, OW. *10 Best Teaching Practices: How Brain Research, Learning Styles, and Standards Define Teaching Competencies.* Thousand Oaks, CA: Corwin Press Inc., 2000.

Urban Industrial Arts/Technology Education Council of Winnipeg. *Industrial Arts in Manitoba: A Position Paper.* Winnipeg, MB: Urban Industrial Arts/Technology Education Council of Winnipeg, 1999.

Western Michigan University. The Evaluation Center: *Teacher Evaluation Glossary.* Kalamazoo, MI: Western Michigan University, 2004. Available online at <www.wmich.edu/evalctr/ess/glossary>.

Zemelman, S., D. Daniels, and A. Hyde. *Best Practice: New Standards for Teaching and Learning in America's Schools.* Portsmouth, NH: Heinemann, 1993.

Printed in Canada
Imprimé au Canada