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and Training

The Ontario Curriculum
Grades 9 and 10

Technological Education

1999

Contents

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Introduction

The Ontario Curriculum, Grades 9 and 10: Technological Education, 1999 will be implemented in Ontario secondary schools starting in September 1999 for students in Grade 9 and in September 2000 for students in Grade 10. This document replaces the sections in *The Common Curriculum: Policies and Outcomes, Grades 1–9, 1995* that relate to technological education in Grade 9, and the parts of the following curriculum guidelines that relate to Grade 10:

– *Broad-based Technological Education, Grades 10, 11, and 12, 1995*

– *Computer Studies, Intermediate and Senior Divisions, 1983*

This document is designed for use in conjunction with its companion piece, *The Ontario Curriculum, Grades 9 and 10: Program Planning and Assessment, 1999*, which contains information relevant to all disciplines represented in the curriculum. The planning and assessment document is available both in print and on the ministry's website, at http://www.edu.gov.on.ca.

The Place of Technological Education in the Curriculum

Technological innovation influences all areas of life, from the actions of individuals to those of nations. It addresses basic human needs and provides the tools and processes for the exploration of both the known and the unknown world.

The power of technology, its pervasiveness, and its continual advances demand a rigorous curriculum and the commitment of educators to understand it, promote its responsible use, and enable students to become problem solvers who are self-sufficient, entrepreneurial, and technologically literate. Students must acquire the technological skills and knowledge required to participate in a competitive, global economy. They must become critical and innovative thinkers, able to question, understand, and respond to the implications of technological innovation, as well as to find solutions and develop products.

Technological education focuses on developing students' ability to work creatively and competently with technologies that are central to their lives. Their development as technologically literate individuals throughout elementary and secondary school enhances their success in postsecondary studies and in the workplace. The policy outlined in this secondary school curriculum document is designed to ensure that technological education in Ontario meets the challenges and opportunities of the twenty-first century.

Technological education promotes the integration of learning across subject disciplines. For example, in designing a technological tool, students may gain information about its intended use (social science), about the materials used in its construction (science), about mathematical relationships describing its dimensions and shape (mathematics), and about the aesthetic qualities of its design (the arts); they may also create text that outlines procedures for the tool's use (language). Similarly, technology supports students' work in other subjects. It develops research skills, supports development in literacy and mathematics, and fosters creativity, critical thinking, and problem solving. In addition, it promotes global citizenship and environmental awareness.

Technological education contributes to learning in other areas of the curriculum by providing practical contexts and applications for the knowledge and skills acquired. For example, the technological education program relates to science in that students use scientific principles to design buildings and machines, and to history and social sciences and the humanities in that students assess the impact of the introduction of technologies on historical events. Technological education relies on English and literacy skills for the description of specifications, proposals, and evaluations, and has ties to the arts through its use of various media to model and present ideas and products. In technological education, students also consider the options provided by various technologies as they affect health and physical well-being. The connection to business studies is evident in the application of business principles to the study of the production and marketing of products in technological education.

The technologies grouped under technological education are connected in a number of ways. Each is based on expectations that are organized in identical strands to ensure consistency and rigour in instruction and to enable teachers to integrate the components of various courses. For example, transportation is a vital consideration in courses dealing with construction, manufacturing and fabrication, travel and tourism, and personal services. Similarly, knowledge and skills from computer and information science and computer engineering technology can be readily integrated into other courses in technological education.

Subject matter from any course in technological education can be combined with subject matter from one or more courses in other disciplines to create an interdisciplinary course. The policies and procedures regarding the development of interdisciplinary courses are outlined in the interdisciplinary studies curriculum policy document.

Technological education at the secondary level is a continuation of the elementary science and technology curriculum. Students build on knowledge, basic concepts, and skills learned in elementary school as they begin the study of technology in Grade 9 and continue into Grade 10. The organization of expectations in strands flows from the elementary into the secondary curriculum. In this continuum there is a similar emphasis on key ideas (theory and foundation), technological processes (skills and processes), and the relationship between technology and the world (impact and consequences).

The Program in Technological Education

Overview

Technological education encompasses both broad-based technology and computer studies, each involving a unique approach to curriculum content and delivery. The technological education program in Grades 9 and 10 offers courses in both areas.

Broad-based technology. The philosophy that underlies the teaching of broad-based technology is that students learn best by doing. The curriculum in this area takes an activity-based, project-driven approach to learning that provides students with knowledge, skills, and experiences in communication, construction, design, hospitality and tourism, manufacturing, personal and health services, and transportation. Each area of study is based on a broad, systematic framework of ten concepts that describe the different types of technological knowledge and skills. It is important for students to understand and use these concepts, which can assist them to analyse and classify technological problems and to identify the most effective ways of solving those problems.

The ten concepts used in technological education are the following:

1. *Structure:* The essential physical or conceptual parts of a product, process, or system, including the way in which the parts are constructed or organized.
2. *Material:* The substance or information from which the structure is made.
3. *Fabrication:* The act or process of forming and assembling materials and structures.
4. *Mechanism:* The parts of a structure that allow it to work or function.
5. *Power and energy:* The resource that enables a mechanism to perform work.
6. *Controls:* The means by which a mechanism is activated and regulated.
7. *Systems:* Combinations of interrelated parts (structures and/or mechanisms) that make up a whole and that may be connected with other systems.
8. *Function:* The use for which a product, process, or system is developed.
9. *Aesthetics:* The aspects of a product, process, or system that make it pleasing to the human senses.
10. *Ergonomics:* The aspects of a product, process, or system that allow people to use it efficiently – that is, with minimal waste of time or energy.

*Computer studies***.** Computers and associated technologies can be used in all curriculum areas as tools to enhance and increase learning. In computer studies, which includes two courses, Computer and Information Science and Computer Engineering Technology, the computer itself is the object of study. Computer studies is concerned with how computers represent objects (e.g., a list of names, a graphical image, an electronic circuit) and how they receive and process instructions to manipulate these objects.

All courses offered in technological education are *open* courses, which comprise a set of expectations that are appropriate for all students. (See *The Ontario Curriculum, Grades 9 and 10: Program Planning and Assessment, 1999* for a description of the different types of secondary school courses.)

Courses in Technological Education, Grades 9 and 10

Grade	Course Name	Course Type	Course Code	Credit Value
9	Integrated Technologies	Open	TTI1O	1
10	Communications Technology	Open	TGJ2O	1
10	Computer and Information Science	Open	TIK2O	1
10	Computer Engineering Technology	Open	TEE2O	1
10	Construction Technology	Open	TCJ2O	1
10	Health and Personal Services Technology	Open	TPJ2O	1
10	Hospitality and Tourism Technology	Open	TFJ2O	1
10	Manufacturing Technology	Open	TMJ2O	1
10	Technological Design	Open	TDJ2O	1
10	Transportation Technology	Open	TTJ2O	1

Note: There are no prerequisites for the courses listed above.

A Note About Courses and Credits. Courses offered in technological education may be delivered as half-courses, each earning a half-credit. Half-credit courses, which require a minimum of fifty-five hours of scheduled instructional time, must adhere to the following conditions:

– Courses offered as half-credit courses must include a selection of learning expectations from all strands and must reflect the balance among strands that characterizes the full course.

– A course that is a prerequisite for another course may be offered as two half-courses, but the student must successfully complete both parts of the course to claim the prerequisite.

– The title of each half-credit course must include the designation Part 1 or Part 2. A half-credit (0.5) will be recorded in the credit-value column of both the report card and the Ontario Student Transcript. Students are not required to complete both Part 1 and Part 2 unless the course is a prerequisite for another course that the student wants to take.

Schools may offer more than one Integrated Technologies course in Grade 9. The additional courses will adhere to the expectations outlined for the course in this document, but will focus on different areas of technology from those treated in the main Integrated Technologies course. Students who take the main course may also take the additional course (or courses) in the same year, earning one credit for each course successfully completed.

In Grades 10 to 12, students may earn more than one credit in a technological course for additional time spent to complete tasks, projects, and assignments that further develop and refine their practical skills. The additional units of time and the nature of the assignments involved, as well as the additional credits to be granted (e.g., a half-credit for an additional fifty-five hours of course work), must be established before the start of the course. This provision is made to assist students who are seeking consideration for apprenticeship or licensing.

Teaching Approaches

Technological education involves knowing, doing, testing, designing and building, and evaluating. Teaching and learning approaches should address all of these areas. Students should use projects as a major means of achieving these expectations, and they should be provided with a combination of information and experience that will prepare them to make informed choices about the use of various technologies, to use technology wisely and well, and to solve technological problems. Students will be involved in:

- investigating technological products, systems, and processes;
- gaining knowledge of the principles and processes of technology;
- exploring needs that can be met through technology;
- creating and evaluating alternatives and modifications in relation to these needs;
- developing safe and efficient work habits;
- making products that satisfy defined specifications and standards of quality and safety;
- making connections between technology and society (past, present, and future);
- assessing related career opportunities and requirements;
- developing confidence to contribute to a technological society.

In planning and delivering technological education programs, there should be an open, collaborative, activity-based approach to teaching that accommodates students' interests, aspirations, and learning styles. Teachers and students should plan activities together to ensure that they are meaningful and relevant to students' needs and the requirements of the curriculum.

Activities should be designed to include both individual and team approaches. Technological activities often require individuals to work collaboratively while undertaking a variety of roles and tasks.

Teachers should work collaboratively with colleagues to plan and deliver the curriculum. Teachers can contribute individual expertise in the various areas of technology to ensure the successful implementation of the technological education curriculum. Courses may be developed that integrate with other parts of the school's program.

Curriculum Expectations

The expectations identified for each course describe the knowledge and skills that students are expected to develop and demonstrate in their class work, on tests, and in various other activities on which their achievement is assessed and evaluated.

Two sets of expectations are listed for each *strand*, or broad curriculum area, of each course. The *overall expectations* describe in general terms the knowledge and skills that students are expected to demonstrate by the end of each course. The *specific expectations* describe the expected knowledge and skills in greater detail.

The specific expectations in some courses are organized under subheadings. This organization is not meant to imply that the expectations in any one group are achieved independently of the expectations in the other groups. The subheadings are used merely to help teachers focus on particular aspects of knowledge and skills as they plan learning activities for their students.

Strands

Three strands, or broad curriculum areas, are used to organize the overall and specific expectations for each course in the technological education program. While each strand is represented in all courses, not all parts of the definition of each strand may apply to all courses.

*Theory and foundation***.** The key ideas about concepts, components and systems, materials, services, and products.

Skills and processes. The technological skills and processes required for responding to a variety of practical challenges.

Impact and consequences. Safety-related issues, career opportunities, and the implications of technology.

Integrated Technologies, Grade 9, Open (TTI1O)

This course enables students to understand the technological and computer concepts they will need in order to design, develop, and build usable products or to deliver services, as well as to pursue further technological studies. Students will use the technological design process and a variety of tools and software to solve problems, complete projects, and strengthen their communication skills.

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- demonstrate understanding of how to develop products or provide services to meet identified needs;
- identify ways to communicate design and research ideas and solutions through a variety of media;
- demonstrate understanding of how to evaluate project work in relation to identified specifications, using quality control procedures;
- describe the scope of activities supported by computer and information technology;
- explain the fundamental concepts underlying the creation of a computer program.

Specific Expectations

By the end of this course, students will:

– identify solutions to given design problems that involve existing situations or new ideas;

– describe a problem-solving model that can be applied to different kinds of technological problems;

– describe project ideas and solutions;

– demonstrate understanding of how to evaluate projects and an ability to suggest improvements;

– demonstrate knowledge of quality control procedures, such as ISO 9002, to determine that projects meet original design specifications;

– describe the fundamental building blocks of a computer program (i.e., constants and variables, selection and repetition, input and output);

– explain the different roles that computers, networks, and operating systems have and describe the tasks for which each is used;

– explain how a local business such as a restaurant or courier service or industry would operate or deliver services with and without computer technology.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- fabricate products or deliver services using a design process and a variety of tools and equipment;
- share information locally and globally using communication tools such as e-mail;
- use a variety of computer software applications for research, to solve problems, and to document the design process;
- identify production techniques and materials to meet design specifications;
- use correctly a problem-solving model, such as the scientific method or a decision-making model, completing all the required steps.

Specific Expectations

By the end of this course, students will:

– use the design process correctly in the completion of projects;

– demonstrate understanding of the roles played by various team members in a group project;

– share information using media tools and a variety of technologies;

– use a variety of software applications, such as word processing, to document projects from conception to completion;

– use a variety of software applications, such as databases and spreadsheets, to do research and solve specific problems;

– determine and compare the costs of computer system components;

– select appropriate resources and materials when designing projects, and use them correctly;

– fabricate products or perform services using hand tools, power tools, and other equipment safely;

– write simple computer programs to manipulate text and graphics.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- apply safety standards when using materials, tools, and equipment;
- describe the environmental effects of materials, processes, and resources;
- demonstrate understanding of how developments in technology influence people's lives;
- identify technology-based careers and their educational requirements;
- apply acceptable-use guidelines/policies for software, equipment, and materials.

Specific Expectations

By the end of this course, students will:

– identify the safety features of tools, materials, and processes;

– handle computer hardware and electrical components safely;

– use appropriate strategies to prevent potential health and safety problems;

– describe environmental, ecological, and social considerations related to the use of technologies, processes, and natural resources;

– identify the impact of technology at home, work, and school, and in recreational pursuits;

– identify computer and technology-related careers and demonstrate understanding of how technology affects selected careers;

– identify acceptable-use policies for computing.

Communications Technology, Grade 10, Open (TGJ2O)

This course requires students to complete a range of communications technology projects. These may include creating printed stationery, short videos, computer-generated animations, and graphical information displays. Students will learn to transfer information using electronic, live, and graphic communications methods. The knowledge and skills they will develop will provide a basis for careers in areas such as publishing, advertising, print production, animation, photography, and journalism.

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- identify and describe the techniques used to produce print media;
- identify and describe the basic techniques required to produce animations and audio-video productions;
- identify and describe the processes of capturing still images;
- demonstrate understanding of electronic communication equipment.

Specific Expectations

By the end of this course, students will:

– explain the techniques used to produce technical drawings and illustrations;

– identify basic composition and typographic principles;

– describe the characteristics of materials used in print production;

– describe printing and finishing processes;

– describe various video recording techniques;

– outline the procedures required to create audio-video, audio, and animated productions;

– outline the steps used to edit audio-video, audio, and animated productions;

– identify the types and uses of still photography;

– identify various cameras and accessories and describe how to test the component parts;

– explain the process of developing and printing photographic images;

– identify the elements of lighting and staging.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- prepare camera-ready artwork for print and post-production;
- produce audio-video and/or animated productions;
- compose, capture, and process still images;
- use computer graphics software competently.

Specific Expectations

By the end of this course, students will:

– produce technical drawings and illustrations for printing;

– apply composition and typographic principles to produce camera-ready artwork for print production;

– produce printed copies using a variety of reproduction methods;

– apply finishing operations to printed products;

– create various effects using video and digital camera techniques;

– use basic lighting techniques and props competently to accentuate audio-video productions;

– create simple animations using video cameras;

– edit audio-video and/or animated productions;

– create still images using composition techniques;

– process and obtain prints from film and/or digital input;

– enhance or create sets, lighting schemes, and information displays.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- explain the benefits, risks, and ethics associated with communications technology;
- observe safety rules and regulations;
- identify career opportunities in the communications field.

Specific Expectations

By the end of this course, students will:

– identify strengths and weaknesses of graphic, electronic, and live communications;

– operate equipment safely;

– apply health and safety standards when using products and materials;

– identify career opportunities and develop appropriate education plans;

– demonstrate knowledge of ethical standards and policies for communications technology.

Computer and Information Science, Grade 10, Open (TIK2O)

This course introduces students to computer science concepts. Students will learn about the stages in software design; the fundamental programming constructs of sequence, selection, and repetition; the functions of internal and external computer components; the relationship among networks, operating systems, and application software and their uses; and how programming languages evolve. Students will also develop an awareness of computer-related careers.

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- describe the stages in the software design process;
- define and explain the fundamental programming constructs;
- describe the functions of internal and external computer components;
- describe the relationship among networks, operating systems, and application software and explain their uses.

Specific Expectations

Problem Solving, Logic, and Design

By the end of this course, students will:

– use input, processing, and output correctly as a model for solving problems using a computer;

– explain how clarity at each step in the problem-solving process determines the quality and effectiveness of the final product;

– define a problem by identifying the required result, the necessary user inputs, and the steps required to produce the result.

Hardware, Interfaces, and Networking Systems

By the end of this course, students will:

– use correct terminology to describe hardware concepts;

– identify the basic internal components of the computer;

– identify the functions of peripheral devices;

– describe operating system functions that meet user needs;

– describe networking system functions that meet user needs;

– compare and contrast application, programming, and systems software.

Programming Concepts

By the end of this course, students will:

– use correct terminology to describe programming concepts;

– describe the types of data that computers store, including numbers and characters;

– define constants, variables, expressions, and assignment statements, including the order in which the operations are performed;

– explain the need for decision and repetition structures, and how they can be expressed in different programming languages;

– explain the difference between logic and syntax errors;

– explain the role of internal documentation in ensuring program correctness and clarity.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- apply a problem-solving model;
- select software to solve specific problems;
- use proper programming practice;
- create computer programs using fundamental programming constructs;
- use correctly an operating system that includes a local network to perform management tasks.

Specific Expectations

Problem Solving, Logic, and Design

By the end of this course, students will:

– state problems accurately to gain a clear understanding of what is required for a solution;

– identify and resolve ambiguities and missing information in a problem statement;

– design a simple method to obtain clear and precise information from the user;

– state the steps required to take user input and produce correct output;

– solve and verify solutions to simple problems using application software, calculators, and computer programs;

– compare and contrast a variety of tools, such as application software, calculators, and computer programs, based on ease of use and time required.

Hardware, Interfaces, and Networking Systems

By the end of this course, students will:

– use correctly file management techniques to create, name, copy, move, delete, and organize files;

– use correctly networking services to log on and off and access shared files and devices;

– use correctly Internetworking services to access and navigate global information resources;

– develop resources to share information locally and globally;

– maintain backup copies of program files on different media.

Programming Concepts

By the end of this course, students will:

– write numbers and characters in such a way that computers recognize them (e.g., place quotation marks around characters);

– use correctly constants, variables, expressions, and assignment statements to store and manipulate numbers and characters in a program;

– use descriptive naming conventions for constants, variables, and expressions;

– write input and output statements that conform to a program design;

– write programs that compare data using constants, variables, and expressions;

– write a program that uses a decision structure involving two or more alternatives;

– write a program that uses a counted repetition structure;

– use appropriate sequences, decisions, and loops to conform to a program design;

– incorporate internal documentation to a specific set of standards to ensure clarity and maintainability;

– trace the execution of programs to find and correct logic and syntax errors;

– validate a program using appropriate data.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- describe the evolution of programming languages;
- identify the social impact of computers and associated technologies;
- identify related computer careers.

Specific Expectations

By the end of this course, students will:

– describe the evolution of different levels of programming languages;

– describe the need to translate higher-level languages to machine code to make a computer operable;

– explain major developments in information technology and anticipate future changes;

– describe software-related careers;

– describe how computers change the ways in which information is collected and used and explain how this affects people's privacy and access to information;

– describe how computers change the ways in which people live, work, and communicate;

– comply with acceptable computer use policies;

– use appropriate strategies to prevent potential health and safety problems associated with computer use, such as posture problems, eye strain, and musculoskeletal injuries.

Computer Engineering Technology, Grade 10, Open (TEE2O)

This course examines computer hardware and the control of external components from an engineering perspective. Student will learn how to solve problems, and will study the functions of key computer components and peripherals, logic gates, fundamental programming concepts, internal numbering and character representation systems, and operating systems and networks. Students will also develop an awareness of potential careers in the field of computer engineering.

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- describe how the internal components of the computer enable the peripherals to function;
- describe a problem-solving model such as the input, processing, output model;
- explain internal numbering and character representation systems;
- describe and illustrate the functions of logic gates;
- describe the fundamental programming constructs.

Specific Expectations

Computer Logic

By the end of this course, students will:

– describe the relationship between the binary number system and computer logic;

– define a standard way of representing characters in binary code;

– describe the function of the fundamental logic gates, including the function of each pin: AND, NAND, OR, NOR, XOR, XNOR, and NOT.

Hardware, Interfaces, and Networking Systems

By the end of this course, students will:

– use precise terminology in relation to all hardware, interfaces, and networking systems;

– identify the basic internal and external components of a computer;

– describe the primary function of each basic component;

– identify computer internals and peripheral devices and describe their relationship.

Programming Concepts

By the end of this course, students will:

– define constants, variables, expressions, and assignment statements, including the order in which the operations are performed;

– describe how computers store and work with different types of data, including numbers and characters.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- connect and use correctly a variety of computer components and peripherals;
- demonstrate the use of an operating system, including a network;
- use logic gates to construct simple circuits;
- apply fundamental programming constructs to develop programs that interact with external components.

Specific Expectations

Computer Logic

By the end of this course, students will:

– convert positive integer numbers to binary form;

– derive the truth tables of the fundamental logic gates;

– write Boolean equations for the fundamental logic gates.

Hardware, Interfaces, and Networking Systems

By the end of this course, students will:

– set up a desktop computer system and install software;

– build an interface to connect the computer to a simple peripheral device;

– trace the operation of a system consisting of a program, an interface, hardware, and directories;

– use appropriate file management techniques;

– use correctly a variety of network system software;

– use Internetworking services correctly to access and navigate global information resources.

Programming Concepts

By the end of this course, students will:

– use input and output statements in a program;

– use a decision structure and a repetition structure in a program;

– design, write, and test a computer program to control a simple peripheral device.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- describe the evolution of computer electronics;
- identify the social impact of computers and associated technologies;
- identify related computer careers.

Specific Expectations

By the end of this course, students will:

– use appropriate strategies to avoid potential health and safety problems associated with computer use, such as posture problems, eye strain, and musculoskeletal injuries;

– use safe practices in the handling of computer hardware and electronic components;

– identify important scientific advances in computer electronic components;

– describe the development of computer engineering technology and its impact;

– describe careers related to computer engineering;

– analyse the influences of computers on the engineering profession;

– describe how computer engineering has evolved and how it has affected people's security, safety, and privacy;

– demonstrate understanding of the importance of ethical computer use;

– demonstrate compliance with acceptable-use policies;

– identify computer skills that are important to employers.

Construction Technology, Grade 10, Open (TCJ2O)

This course requires students to design, build, and evaluate projects using design instruments and machine and hand tools. Students will solve technological problems through a variety of media; identify and describe building materials and other resources needed to construct, maintain, and service buildings; identify support systems and components; apply safety rules related to materials, processes, and equipment; identify common architectural styles; and identify careers related to construction technology.

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- communicate ideas and solutions to technological problems through a variety of media;
- describe the qualities, characteristics, and uses of different types of building materials;
- use technological concepts correctly in the design, fabrication, and evaluation of projects;
- identify the importance of support systems as an integral part of the construction.

Specific Expectations

By the end of this course, students will:

– identify and describe building materials, products, pre-engineered components, and other resources needed to build projects and to construct, maintain, and service buildings;

– describe the products and materials used to construct different types of foundations;

– identify materials, products, and pre-engineered components used to build floor, wall, and roof systems;

– name different types of insulation, doors, and windows and describe their respective uses;

– describe materials and products used in interior and exterior finishes;

– classify materials and products related to cabinet making and millwork;

– name the different types of support systems and describe their respective functions;

– use technological terms correctly in written and oral presentations;

– include the ten technological concepts in the design, production, and evaluation of projects (see p. 4);

– identify electrical devices commonly found in buildings;

– analyse different methods of heating, ventilating, and air conditioning;

– describe the water supply and waste disposal aspects of plumbing.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- demonstrate skill in the use of tools, materials, processes, and systems required to build, maintain, and service construction-related projects;
- apply the design process either individually or in small groups to project assembly;
- apply problem-solving skills to projects;
- use industry-standard tools and equipment correctly.

Specific Expectations

By the end of this course, students will:

– interpret and produce technical drawings using graphic conventions, techniques, instruments, and computer technologies to present solutions to technological problems;

– apply problem-solving methods to investigate, analyse, and resolve the challenges presented when constructing models or mock-ups;

– use correctly tools, equipment, and techniques to dress, measure, cut, mill, assemble, sand, and finish wood;

– use correctly tools, equipment, and techniques to measure, cut, lay out, and assemble structural components and systems;

– use correctly tools, equipment, and techniques applicable to the layout, rough-in, and completion of support systems;

– identify tools, equipment, and techniques needed to install interior and exterior finishes;

– identify common tools and equipment used to maintain and service a building;

– use a design process correctly.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- identify common architectural styles and building materials;
- recognize and describe the impacts of construction technology on society and the environment;
- describe the factors affecting the quality of life of occupants within buildings;
- apply safety standards as they relate to processes, materials, tools, and equipment in the construction industry;
- identify and describe careers in construction technology and the education and training required for entry into those positions.

Specific Expectations

By the end of this course, students will:

– identify building designs from different architectural eras;

– describe the evolution of materials, methods, and building codes through different architectural eras;

– explain the economic, ecological, social, and safety concerns in choosing a particular energy source;

– explain the purpose of building codes in relation to health and safety;

– analyse the importance of design on the quality of life in residential, commercial, recreational, and industrial facilities;

– identify the qualities of effective heating, ventilation, and lighting systems;

– apply health and safety standards related to materials, processes, tools, and equipment;

– explain the impact and application of health and safety laws and regulations;

– identify career opportunities and the skills and education needed to achieve career goals;

– identify some impacts of construction on society and the environment.

Health and Personal Services Technology, Grade 10, Open (TPJ2O)

This course emphasizes technological applications in the areas of health care and personal services. Students will learn to describe and evaluate professional practices and principles; to select and use technical resources to solve problems; and to use materials, tools, and equipment safely. They will also acquire transferable skills for changing work environments, personal management skills, and knowledge of entry requirements for careers in this area.

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- describe the scope of the health care industry;
- describe the scope of the personal services industry;
- describe appropriate software applications;
- identify and describe specialized tools and equipment.

Specific Expectations

By the end of this course, students will:

– describe the role of the health care industry locally, provincially, and nationally;

– describe the role of the personal services industry locally, provincially, and nationally;

– identify and use software appropriate to client or patient needs;

– describe industry standards for various working environments;

– demonstrate understanding of the uses of tools and equipment.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- demonstrate understanding of professional practices and principles;
- demonstrate understanding of the importance of interpersonal and time-management skills;
- find solutions to specified problems;
- demonstrate research and communication skills;
- demonstrate understanding of community resources.

Specific Expectations

By the end of this course, students will:

– identify legal and ethical standards of health care and personal services;

– demonstrate a range of personal and team-work techniques in the classroom;

– apply a variety of problem-solving methods to workplace challenges;

– select and use information technology to prepare and present reports;

– communicate effectively with clients and patients;

– describe the personal and health services available in the community.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- demonstrate understanding of the environmental and societal issues related to health care and personal services;
- identify career opportunities in health care and personal services;
- describe industry standards for the use of materials, tools, and equipment.

Specific Expectations

By the end of this course, students will:

– explain the environmental effects of different products;

– demonstrate understanding of the implications of advances in biotechnology;

– identify apprenticeship, certification, and postsecondary entry requirements related to health and personal services careers;

– describe the education and training required to achieve career goals;

– identify laws and regulations that relate to health issues;

– apply personal, health, and workplace safety regulations in handling materials, tools, and equipment.

Hospitality and Tourism Technology, Grade 10, Open (TFJ2O)

This course emphasizes the scope of the hospitality and tourism industry. Students will study food origins, food-handling techniques and food preparation, health and safety standards, and the use of specialized tools and equipment. They will also investigate travel and tourism activities in Ontario, develop effective communication and management skills, and identify career opportunities in the hospitality and tourism industry.

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- describe the scope of the tourism and hospitality industries;
- describe geographical locations of food origins;
- identify and describe the equipment, tools, and procedures used to measure and handle food products.
- describe regional tourism activities;
- demonstrate knowledge of related specialized tools and equipment.

Specific Expectations

By the end of this course, students will:

– identify the role of the food services industry locally, provincially, nationally, and internationally;

– identify the role of the travel and tourism industry locally, provincially, nationally, and internationally;

– identify where food products originate;

– report on conferences, events, attractions, and other tourism opportunities;

– demonstrate understanding of some tools and equipment used in the tourism industry, such as advertising and Internet shopping;

– demonstrate knowledge of measuring techniques;

– demonstrate an understanding of safe food-handling procedures.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- select and use tools and equipment for food preparation, handling, storage, and serving;
- organize and advertise small-scale excursions and events;
- demonstrate different cooking methods;
- demonstrate software applications used in the hospitality and tourism fields;
- demonstrate understanding of the importance of communication, time-management, and teamwork skills.

Specific Expectations

By the end of this course, students will:

– apply proper food-handling and food-processing techniques;

– operate kitchen, baking, and confectionary equipment;

– use correctly a variety of cooking methods to prepare simple recipes;

– describe computerized travel management systems and other software applications;

– describe computerized food services management systems;

– demonstrate a range of teamwork, organizational, and communication skills;

– understand the importance of accurate measurement techniques, such as those used in calculating survey results, in measuring liquids, in accounting for money.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- demonstrate understanding of environmental and social issues related to hospitality and tourism;
- apply industry standards related to personal and workplace hygiene;
- identify professional opportunities in hospitality and tourism;
- explain health and safety standards as they relate to processes, materials, tools, and equipment in the hospitality and tourism industry.

Specific Expectations

By the end of this course, students will:

– explain the challenges of environmental sustainability in ecotourism;

– identify the purposes of standards in the food services industry;

– explain the impact and application of health and safety laws and regulations;

– describe related career opportunities and the education and training required to gain entry to those positions;

– demonstrate the ability to apply personal, health, and workplace safety regulations in the handling of equipment and materials;

– demonstrate knowledge of emergency procedures.

Manufacturing Technology, Grade 10, Open (TMJ2O)

This course introduces students to the scope of the manufacturing industry, the various components used in the design of products, the industrial tools and equipment used, and methods of manufacturing, including assembly-line production. Students will learn about technical drawing; preparation processes; manufacturing techniques; power, electronic, and quality control systems; careers in the manufacturing field; and the role of entrepreneurs in Canadian society.

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- describe the scope of the manufacturing industry;
- communicate project ideas using a variety of methods;
- select materials, industrial tools, and equipment to manufacture products;
- analyse and solve manufacturing problems;
- demonstrate understanding of manual and assembly-line production.

Specific Expectations

By the end of this course, students will:

– identify the role of the manufacturing sector locally, provincially, nationally, and internationally;

– identify the various components used in the design of manufactured products;

– identify and describe industrial tools and materials;

– describe various methods of manufacturing;

– identify the stages and equipment used in assembly-line production.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- recognize market opportunities;
- apply the planning and design process to specific projects;
- use the manufacturing process correctly in specific projects;
- assess processes and the resultant products.

Specific Expectations

By the end of this course, students will:

– use market research correctly to test consumer response to design solutions;

– follow a design process that includes identification of the design problem, design considerations, multiple solutions, analysis, and evaluation;

– select appropriate materials for predetermined projects;

– develop production flow charts that include group member duties and manufacturing schedules;

– perform the preparation processes required to manufacture products;

– select methods of generating, transmitting, and transforming power;

– apply various electrical and electronic controls;

– describe the purpose of quality control processes;

– evaluate projects using assessment instruments and identify design alterations;

– prepare and present design briefs.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- explain health and safety standards as they relate to processes, materials, tools, and equipment in the manufacturing industry;
- identify career opportunities in the manufacturing industry;
- demonstrate understanding of the social and environmental effects of the manufacturing industry.

Specific Expectations

By the end of this course, students will:

– apply personal and health and safety regulations in the handling of equipment and materials;

– describe careers in manufacturing technology and the education and training required for entry into those positions;

– describe the role of manufacturing entrepreneurs in Canadian society;

– demonstrate understanding of the ecological ramifications of manufacturing.

Technological Design, Grade 10, Open (TDJ2O)

This course requires students to design and develop innovative products and services. Students will learn the following: how to identify user needs related to specified design problems; the physical properties of selected materials and their application in product design; techniques to create physical products and services; various presentation techniques; how to test and evaluate design solutions; and the implications of technology on the development of products or services. They will also become aware of design-related careers.

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- identify user needs related to specified design projects;
- describe the processes used to develop products;
- identify the design criteria applicable to existing products and services related to project activities;
- identify the physical properties of selected materials and their application in product design;
- describe methods to test and evaluate design solutions.

Specific Expectations

By the end of this course, students will:

– identify user needs related to given design problems;

– describe the process of design and manufacturing and apply their knowledge to the design of projects;

– compare consumer products or services using criteria such as functionality, reliability, materials selection, ease of use, and durability;

– demonstrate knowledge of the physical characteristics of materials and define how they are used in products;

– communicate ideas using a variety of methods;

– describe testing and evaluating criteria for project materials or components.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- analyse design criteria from given design briefs;
- design and fabricate models, prototypes, or mock-ups;
- test solutions against design criteria and identify potential implementation problems;
- illustrate ideas and solutions using hand-drawn and computer illustrations, as well as technical drawings;
- generate research reports and presentation materials for review.

Specific Expectations

By the end of this course, students will:

– develop reports on criteria for given design challenges and suggest solutions;

– fabricate models, prototypes, or mock-ups for testing and analysis;

– establish test criteria and use them to test projects;

– assess, select, and use illustration and modelling techniques;

– describe the process used to solve project design problems.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- apply safety standards when using materials, tools, and equipment;
- illustrate how technology has affected the development of products or services;
- demonstrate understanding of the strategies used by advertisers to market products or services;
- explain how the choice and use of materials may affect the environment;
- identify design-related careers.

Specific Expectations

By the end of this course, students will:

– identify the safety features of tools, materials, and processes;

– use appropriate strategies to prevent potential health and safety problems;

– describe the evolution of a system, product, or service;

– identify the methods used in advertising project-related products or services;

– describe the environmental concerns related to the use of particular raw materials;

– describe functions of personnel working in design-related careers;

– identify career opportunities and the skills and education needed to achieve career goals.

Transportation Technology, Grade 10, Open (TTJ2O)

This course requires students to build projects and to learn service procedures related to different modes of transportation. Students will learn about support systems for transporting people and products; measurement systems and methods; the analysis, design, and construction of a system to convert and make practical use of energy; the function of major vehicle system components; the impact of transportation systems on the environment; communication skills; and transportation-related careers.

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- describe the evolution of transportation technologies;
- identify and describe different modes of transportation;
- explain the importance of service and support systems to the transportation of people and products;
- identify and describe different methods for converting, using, distributing, and storing energy;
- describe the correlation between modes of transportation and the need for related support businesses.

Specific Expectations

By the end of this course, students will:

– identify current safety standards in transportation and secondary industries;

– demonstrate knowledge of service procedures for different types of transportation vehicles;

– describe various maintenance and support technologies related to the transportation of people and products;

– describe the operation and application of major vehicle propulsion devices and the procedures used for servicing them;

– identify and explain technologies for joining materials and describe their application;

– describe the distribution network for fuel or energy required by transportation systems;

– describe principles of design that apply in conserving energy in project work;

– suggest improvements to a current transportation system to suit local conditions;

– describe the importance of secondary industries for the transportation industry;

– demonstrate knowledge of different propulsion systems.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- demonstrate accuracy in the use of measuring systems and methods;
- design and construct systems to convert and make practical use of energy;
- describe the function of major vehicle system components;
- use a variety of fastening, fabrication, maintenance, and repair techniques correctly in projects.

Specific Expectations

By the end of this course, students will:

– produce projects that demonstrate knowledge of a variety of transportation technologies;

– use measurement tools correctly to inspect and service vehicle systems;

– identify wear on vehicle system components on the basis of industry standards;

– design and construct propulsion systems capable of propelling vehicles for a variety of transportation modes under varying conditions;

– describe and maintain support systems related to vehicle operation;

– adapt a secondary system to control a propulsion system;

– use a variety of technologies for joining materials;

– repair or replace components to meet or exceed original equipment manufacturer (OEM) standards.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- describe the impact of transportation technology on society and the environment;
- identify career opportunities in transportation-related fields and the education and training required for entry into those positions;
- demonstrate understanding of methods for increasing the efficiency of energy use;
- apply health and safety standards related to materials, processes, and equipment.

Specific Expectations

By the end of this course, students will:

– identify methods for improving the efficiency of energy consumption in the transportation industry;

– describe changes made to vehicle systems to enable them to use energy more efficiently;

– explain the need to manufacture and dispose of vehicle system components in an environmentally friendly way;

– describe the refinement and utilization of energy sources from their raw materials to their disposal;

– identify local systems that deal with recycling in the transportation industry;

– describe related career opportunities and the education and training required to gain entry to these positions;

– describe health and safety regulations for the handling of tools, fuels, materials, and equipment.

Some Considerations for Program Planning in Technological Education

Teachers who are planning a program in technological education must take into account considerations in a number of important areas. Essential information that pertains to all disciplines is provided in the companion piece to this document, *The Ontario Curriculum, Grades 9 and 10: Program Planning and Assessment, 1999*. The areas of concern to all teachers that are outlined there include the following:

- types of secondary school courses
- education for exceptional students
- the role of technology in the curriculum
- English as a second language (ESL) and English literacy development (ELD)
- career education
- cooperative education and other workplace experiences
- health and safety

Considerations relating to the areas listed above that have particular relevance for program planning in techological education are noted here.

Education for Exceptional Students. In planning courses in technological education, teachers must ensure that accommodations are made to meet the needs of exceptional students as set out in their Individual Education Plan. For example, teachers should recognize that some students may require focused and specialized directions, and advance practice in using equipment, perhaps with the help of a peer. Issues relating to students' ability to use equipment and read accompanying manuals must be addressed before students can be expected to participate effectively.

The Role of Technology in the Curriculum. Technological education encompasses both broad-based technology and computer studies, each of which is unique in its approach to information technology. Students will use applications such as computer-assisted design, engine analysis software, or network management software specific to technological education courses. Using an activity-based, project-driven approach to learning, they will also develop information technology skills to support their development of knowledge and other skills. Students will have an opportunity to create software by designing, writing, and testing computer programs, and they will also learn to assemble, manage, and troubleshoot the complex systems that support these computing activities.

Career Education. In each technological education course, students assess related education and career opportunities and requirements, as well as the pathways from school to work. Where possible, students will visit work sites and interact with volunteer mentors. In addition, by learning to work independently and cooperatively to complete relevant tasks and produce useful products, students will appreciate and understand the expectations of the workplace.

Cooperative Education and Other Workplace Experiences. Technological education programs lend themselves well to planned learning activities outside the classroom. Programs should be designed to take into account local opportunities for students to combine work experience and classroom learning. Programs may also be modified to reflect community needs. In- and out-of-class components must be carefully matched and monitored so that students' learning experiences are relevant and authentic.

Health and Safety. Health and safety are of paramount importance in technological education programs. As part of every course, students must be made aware that health and safety are everyone's responsibility – at home, at school, and in the workplace. Before using equipment, students must be able to demonstrate knowledge of the equipment being used and the procedures necessary for its safe use. Personal protective gear should be worn as appropriate.

Classroom practice and the learning environment should comply with relevant municipal, provincial, or federal health and safety legislation, including the following:

- the Workplace Safety and Insurance Act
- the Workplace Hazardous Materials Information System (WHMIS)
- the Food and Drug Act
- the Health Protection and Promotion Act
- the Ontario Building Code
- the Occupational Health and Safety Act
- local by-laws

Teachers must make use of all available and relevant resources to make students sufficiently aware of the importance of health and safety. These can include materials from the following:

- Workplace Safety and Insurance Board (WSIB)
- Industrial Accident Prevention Association (IAPA)
- Ontario Ministry of Labour (MOL)
- Canadian Centre for Occupational Health and Safety (CCOHS)
- appropriate Safe Workplace Associations (SWAs) and clinics, such as the Industrial Accident Prevention Association (IAPA), the Construction Safety Association of Ontario (CSAO), the Ontario Service Safety Alliance (OSSA), the Transportation Safety Association of Ontario (TSAO), the Electrical Utilities Safety Association (EUSA), the Workers Health and Safety Centre (WHSC), and the Occupational Health Clinics for Ontario Workers.

The Achievement Chart for Technological Education

The achievement chart that follows identifies four categories of knowledge and skills in technological education – Knowledge/Understanding, Thinking/Inquiry, Communication, and Application. These categories encompass all the curriculum expectations in courses in the discipline. For each of the category statements in the left-hand column, the levels of student achievement are described. (Detailed information on the achievement levels and on assessment, evaluation, and reporting policy is provided in *The Ontario Curriculum, Grades 9 and 10: Program Planning and Assessment, 1999*.)

The achievement chart is meant to guide teachers in:

- planning instruction and learning activities that will lead to the achievement of the curriculum expectations in a course;
- planning assessment strategies that will accurately assess students' achievement of the curriculum expectations;
- selecting samples of student work that provide evidence of achievement at particular levels;
- providing descriptive feedback to students on their current achievement and suggesting strategies for improvement;
- determining, towards the end of a course, the student's most consistent level of achievement of the curriculum expectations as reflected in his or her course work;
- devising a method of final evaluation;
- assigning a final grade.

The achievement chart can guide students in:

- assessing their own learning;
- planning strategies for improvement, with the help of their teachers.

The achievement chart provides a standard province-wide method for teachers to use in assessing and evaluating their students' achievement. Teachers will be provided with materials that will assist them in improving their assessment methods and strategies and, hence, their assessment of student achievement. These materials will contain samples of student work (exemplars) that illustrate achievement at each of the levels (represented by associated percentage grade ranges). Until these materials are provided, teachers may continue to follow their current assessment and evaluation practices.

To ensure consistency in assessment and reporting across the province, the ministry will provide samples of student work that reflect achievement based on the provincial standard, and other resources based on the achievement charts. As these resources become available, teachers will begin to use the achievement charts in their assessment and evaluation practices.

To support this process, the ministry will provide the following:

- a standard provincial report card, with an accompanying guide
- course profiles
- exemplars
- curriculum and assessment videos
- training materials
- an electronic curriculum planner

When planning courses and assessment, teachers should review the required curriculum expectations and link them to the categories to which they relate. They should ensure that all the expectations are accounted for in instruction, and that achievement of the expectations is assessed within the appropriate categories. The descriptions of the levels of achievement given in the chart should be used to identify the level at which the student has achieved the expectations. Students should be given numerous and varied opportunities to demonstrate their achievement of the expectations across the four categories. Teachers may find it useful to provide students with examples of work at the different levels of achievement.

The descriptions of achievement at level 3 reflect the provincial standard for student achievement. A complete picture of overall achievement at level 3 in a course in technological education can be constructed by reading from top to bottom in the column of the achievement chart headed "70-79% (Level 3)".

Achievement Chart – Grades 9–10, Technological Education

Categories	50–59% (Level 1)	60–69% (Level 2)	70–79% (Level 3)	80–100% (Level 4)
Knowledge/ Understanding	The student:			
– knowledge of facts, technical terminology, procedures, and standards	– demonstrates limited knowledge of facts, technical terminology, procedures, and standards	– demonstrates some knowledge of facts, technical terminology, procedures, and standards	– demonstrates considerable knowledge of facts, technical terminology, procedures, and standards	– demonstrates thorough knowledge of facts, technical terminology, procedures, and standards
– understanding of concepts (e.g., uses of computer operating systems)	– demonstrates limited understanding of concepts	– demonstrates some understanding of concepts	– demonstrates considerable understanding of concepts	– demonstrates thorough and insightful understanding of concepts
– understanding of relationships between concepts (e.g., energy conservation and manufacturing processes)	– demonstrates limited understanding of relationships between concepts	– demonstrates some understanding of relationships between concepts	– demonstrates considerable understanding of relationships between concepts	– demonstrates thorough and insightful understanding of relationships between concepts
Thinking/Inquiry	The student:			
– thinking skills (e.g., evaluating professional practices and principles)	– uses thinking skills with limited effectiveness	– uses thinking skills with moderate effectiveness	– uses thinking skills with considerable effectiveness	– uses thinking skills with a high degree of effectiveness
– inquiry/design skills (e.g., identifying the problem; formulating questions; planning; selecting strategies and resources; analysing and interpreting information; forming conclusions)	– applies few of the skills involved in an inquiry/design process	– applies some of the skills involved in an inquiry/design process	– applies most of the skills involved in an inquiry/design process	– applies all or almost all of the skills involved in an inquiry/design process
Communication	The student:			
– communication of information (e.g., computer and technical specifications)	– communicates information with limited clarity	– communicates information with moderate clarity	– communicates information with considerable clarity	– communicates information with a high degree of clarity, and with confidence
– use of language, symbols, and visuals (e.g., computer programming and technical drawing)	– uses language, symbols, and visuals with limited accuracy and effectiveness	– uses language, symbols, and visuals with some accuracy and effectiveness	– uses language, symbols, and visuals with considerable accuracy and effectiveness	– uses language, symbols, and visuals with a high degree of accuracy and effectiveness

Categories	50–59% (Level 1)	60–69% (Level 2)	70–79% (Level 3)	80–100% (Level 4)
Communication (cont.)	The student:			
– communication for different audiences and purposes (e.g., tourism, marketing)	– communicates with a limited sense of audience and purpose	– communicates with some sense of audience and purpose	– communicates with a clear sense of audience and purpose	– communicates with a strong sense of audience and purpose
– use of various forms of communication (e.g., presentation software)	– demonstrates limited command of the various forms	– demonstrates moderate command of the various forms	– demonstrates considerable command of the various forms	– demonstrates extensive command of the various forms
Application	The student:			
– application of ideas and skills in familiar contexts (e.g., demonstrating good customer service practices)	– applies ideas and skills in familiar contexts with limited effectiveness	– applies ideas and skills in familiar contexts with moderate effectiveness	– applies ideas and skills in familiar contexts with considerable effectiveness	– applies ideas and skills in familiar contexts with a high degree of effectiveness
– transfer of concepts, skills, and procedures to new contexts (e.g., applying scientific principles to health care and personal services)	– transfers concepts, skills, and procedures to new contexts with limited effectiveness	– transfers concepts, skills, and procedures to new contexts with moderate effectiveness	– transfers concepts, skills, and procedures to new contexts with considerable effectiveness	– transfers concepts, skills, and procedures to new contexts with a high degree of effectiveness
– application of procedures, equipment and technology (e.g., use of design instruments, machine and hand tools)	– uses procedures, equipment, and technology safely and correctly only with supervision	– uses procedures, equipment, and technology safely and correctly with some supervision	– uses procedures, equipment, and technology safely and correctly	– demonstrates and promotes the safe and correct use of procedures, equipment, and technology
– making connections (e.g., between personal experiences and the subject, between subjects, between subjects and the world outside the school)	– makes connections with limited effectiveness	– makes connections with moderate effectiveness	– makes connections with considerable effectiveness	– makes connections with a high degree of effectiveness

Explanatory Notes

The following definitions of terms are intended to help teachers and parents/guardians use this document. It should be noted that, where examples are provided, they are suggestions and are not meant to be exhaustive.

acceptable-use policies. A code or set of policies or guidelines stipulating expectations and rules regarding the use of computers and associated technologies.

application software. A software program or set of programs designed to meet a specific user need (e.g., word processing, creating spreadsheets).

assignment statement. A statement that stores a specified value in a variable.

binary code. The only instructions that the computer is able to execute directly. Binary code consists of combinations of zeros and ones that represent high and low electrical states.

Boolean equations. Equations containing variables that can have one of two values: true or false.

character representation system. The method by which characters and numbers are stored internally in the computer (e.g., ASCII or unicode).

constant. A variable whose value never changes during the execution of a program or process.

decision structure. A control structure used to determine whether a specific action will be taken.

design brief. A technical report that documents all of the stages of the design process.

design process. The stages of development of a product or process, including developing a focus, developing a framework, choosing the best solution, implementing a plan, and reflecting on the process and the product.

documentation, internal. Descriptions that appear in a computer program in English or mathematics that help make the program more understandable. Often used to explain the function of a specific part of a program.

expression. Any valid combination of variables, constants, operators, and parentheses.

health and safety problems. Health and safety problems include injuries, illness, diseases, or fatalities that can arise in the workplace from the improper use of materials and equipment, exposure to toxic substances, the lack of use or improper use of personal protective equipment, or the existence of other hazardous conditions.

health and safety standards. Safety guidelines and procedures, such as the Workplace Hazardous Materials Information System (WHMIS), set up by industry and government for the safe use of tools and equipment and the safe handling of materials.

interface. A common boundary between adjacent systems to enable them to interact.

Internetworking. The use of a set of computer tools and services such as browsers to facilitate global communication.

live communications. The study of photography (moving and still) and stage productions.

logic gate. A circuit with two or more inputs and one output that allow signals to pass when certain predefined criteria are met.

management systems. The individual components used to manage a specific part of one of the six technologies used in vehicle development. Management systems can be built in as part of the overall control system. (*See* vehicle systems.)

musculoskeletal injury. An injury of muscles, ligaments, or tendons caused from overexertion due to frequency, force of movement, duration, or sustained awkward posture.

network. Integrated computer systems, workstations, and communication links.

OEM. Original equipment manufacturer.

operating system. A collection of programs that permit a computer to manage itself and make efficient use of its resources.

peripheral. A device in a system that is not part of the central computer but is used for input or output purposes (e.g., scanners, printers).

programming construct. A set of programming language instructions for performing a particular task (e.g., looping, selection, or repetition).

repetition structure. A control structure used to indicate that an instruction is to be executed until a condition is met or a counting index reaches a certain value.

software design process. The process or steps, from design to completion, for developing an algorithm, a computer program, or an application.

support systems. Auxiliary systems such as plumbing, electrical, or heating systems.

syntax error. A violation of the grammatical rules of a programming language.

transportation mode. A custom or style of transportation related to one of the four transportation systems (such as an airplane).

transportation system. A means of moving people or materials from one point to another using different transportation modes. A system comprises vehicles, other supports (maintenance, repair, traffic control, safety aspects, roadways, flight paths, shipping lanes), and the people required to operate it. There are four transportation systems: land, water, atmospheric (air), and space.

transportation technology. Any technology that is used to transport or move people and goods.

truth table. A table displaying all possible input combinations for a circuit, and their associated output values.

typography. The study of typefaces and type styles.

variable. A memory location where information can be stored.

vehicle. Any mechanical conveyance used on land, on sea, or in air or space for the purpose of moving people or objects.

vehicle systems. The six systems or technologies that make up the whole vehicle, including propulsion, guidance, control, suspension, structural, and support systems.

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