2009

REVISED

The Ontario Curriculum
Grades 9 and 10

Technological Education

reach every student

Ontario

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INTRODUCTION

This document replaces all but the Computer and Information Science component of *The Ontario Curriculum, Grades 9 and 10: Technological Education, 1999.* Beginning in September 2009, all technological education courses for Grades 9 and 10 will be based on the expectations outlined in this document.

SECONDARY SCHOOLS FOR THE TWENTY-FIRST CENTURY

The goal of Ontario secondary schools is to support high-quality learning while giving individual students the opportunity to choose programs that suit their skills and interests. The updated Ontario curriculum, in combination with a broader range of learning options outside traditional classroom instruction, will enable students to better customize their high school education and improve their prospects for success in school and in life.

THE IMPORTANCE OF TECHNOLOGICAL EDUCATION IN THE CURRICULUM

Technological innovation influences all areas of life, from the daily lives of individuals to the work of business and government, to interactions on a global scale. It helps meet basic human needs and provides tools for improving people's lives and exploring new frontiers. The policy outlined in this document is designed to ensure that technological education in Ontario enables students to meet the challenges and opportunities of the twenty-first century.

The power, reach, and rapid evolution of technology demand a curriculum that will enable students to become technologically literate – that is, able to understand, work with, and benefit from a range of technologies. Students need to acquire the technological skills and knowledge that will allow them to participate fully in a competitive global economy and to become responsible citizens in an environmentally vulnerable world. To succeed in today's society, students need to be effective problem solvers and critical thinkers, able to understand, question, and respond to the implications of technological innovation. Students who pursue careers in technology will also need these high-level skills to develop solutions to technological challenges or to provide the services required in their chosen fields.

Technological education focuses on developing students' ability to work creatively and competently with technologies that are central to their lives. As they proceed through their elementary and secondary school education, students attain a level of technological literacy that will enhance their ability to succeed in their postsecondary studies or in the workplace. For students who do not choose to pursue careers in technology, technological education can provide knowledge and skills that will enhance their daily lives, whether by enabling them to work on home renovations or car repairs or by allowing them to pursue technological hobbies.

Technological education promotes the integration of learning across subject disciplines. For example, when students design a product, they explore the social or human need that the product addresses (social science), the scientific principles involved in its design and construction (science), its dimensions and shape (mathematics), and the aesthetic qualities of its design (the arts). When they assess the impact that new technologies have had – or may have – on society, students are exploring historical or current events. When they consider how various technologies affect health and physical well-being, they are looking into aspects of health and physical education. Students apply business principles to the study of the production and marketing of products. They apply literacy skills to communicate design ideas, produce reports summarizing technological projects, and write instructions for the use of the products they create. Technological education also helps students develop research skills and fosters creativity, critical thinking, and problem solving. In addition, in its emphasis on innovation to meet human needs, it encourages global citizenship and promotes social, economic, and environmental awareness.

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.

The secondary school technological education curriculum is designed to build on the foundation of knowledge and skills provided by the elementary science and technology curriculum, particularly in its Understanding Structures and Mechanisms strand. In this continuum, there is a similar emphasis on foundational knowledge and skills (fundamentals), technological problem-solving skills and processes, and the relationship between technology, the environment, and society.

THE GOALS OF TECHNOLOGICAL EDUCATION

The fundamental purpose of the technological education program is to provide students with knowledge, skills, and attitudes that will enhance their ability to achieve success in secondary school, the workplace, postsecondary education or training, and daily life.

The goals of the technological education curriculum are to enable students to:

- gain an understanding of the fundamental concepts underlying technological education;
- achieve the level of technological competence they will need in order to succeed in their postsecondary education or training programs or in the workplace;
- develop a creative and flexible approach to problem solving that will help them address challenges in various areas throughout their lives;
- develop the skills, including critical thinking skills, and the knowledge of strategies required to do research, conduct inquiries, and communicate findings accurately, ethically, and effectively;
- develop lifelong learning habits that will help them adapt to technological advances in the changing workplace and world;
- make connections that will help them take advantage of potential postsecondary educational and work opportunities.

THE PHILOSOPHY OF BROAD-BASED TECHNOLOGICAL EDUCATION

The philosophy that underlies broad-based technological education is that *students learn best by doing*. This curriculum therefore adopts an activity-based, project-driven approach that involves students in problem solving as they develop knowledge and skills and gain experience in the technological subject area of their choice.

Rather than focusing on specific occupations, courses in this broad-based technology curriculum explore groups of related occupations and industry sectors within particular subject areas. So, for example, workplace preparation courses in construction technology enable students to acquire knowledge and skills related to carpentry, electrical/network cabling, heating and cooling, masonry, and plumbing.

Broad-based technology courses enable students to develop a variety of transferable skills that will serve them well in a complex and ever-changing workplace. For example, problem-solving skills are transferable skills, because they can be applied in a wide variety of situations to solve problems of various kinds. Other transferable skills emphasized in this curriculum are the "Essential Skills" and work habits identified in the Ontario Skills Passport (see pp. 29–30) as the skills and habits that enable people to perform the tasks required in their jobs and to participate fully in the workplace and the community.

FUNDAMENTAL TECHNOLOGICAL CONCEPTS

This curriculum identifies a number of fundamental concepts that inform design and production in various areas of technology. To address technological challenges and solve problems effectively, students need to take the full range of these concepts and elements of technology into account. As they progress through their technological education courses, students will come to understand these concepts more deeply, and to work with them creatively as they confront new challenges.

Fundamental Concepts	
Aesthetics	The aspects of a product, process, or service that make it pleasing to the human senses.
Control	The means by which a device or process is activated or regulated.
Environmental sustainability	The creation of products or services and use of resources in a way that allows present needs to be met without compromising the ability of future generations to meet their needs. An important related concept is that of *environmental stewardship* – the acceptance of responsibility for the sustainable use and treatment of land and other natural resources.
Ergonomics	The design of a product, process, or service in a way that takes the user's well-being with respect to its use or delivery into account – that is, in a way that minimizes discomfort, risk of injury, and expenditure of energy.
Fabrication/ building/creation	The act or process of assembling components and/or materials and resources to create a product or service.
Function	The use for which a product, process, or service is developed.

(continued)

Innovation	Original and creative thinking resulting in the effective design of a product or service.
Material	Any substance or item used in the creation of a product or delivery of a service.
Mechanism	A system of connected parts that allows a product to work or function.
Power and energy	The resource that enables a mechanism to perform work.
Safety	The care and consideration required to ensure that the product, process, or service will not cause harm.
Structure	The essential physical or conceptual parts of a product, process, or service, including the way in which the parts are constructed or organized.
Systems	The combinations of interrelated parts that make up a whole and that may be connected with other systems.

ROLES AND RESPONSIBILITIES IN TECHNOLOGICAL EDUCATION

Students

Students have many responsibilities with regard to their learning. Students who make the effort required to succeed in school and who are able to apply themselves will soon discover that there is a direct relationship between this effort and their achievement, and will therefore be more motivated to work. There will be some students, however, who will find it more difficult to take responsibility for their learning because of special challenges they face. The attention, patience, and encouragement of teachers can be extremely important to the success of these students. However, taking responsibility for their own progress and learning is an important part of education for all students, regardless of their circumstances.

Mastering the concepts and skills connected with technological education requires work, study, and the development of cooperative skills. In addition, students who actively pursue opportunities outside the classroom will extend and enrich their understanding of technology. Their understanding and skills will grow as they engage in recreational activities that involve technology (e.g., model building), reading related to technology (e.g., magazines, Internet sources), and learning about technological advances (e.g., attending technology fairs).

Parents

Parents[1] have an important role to play in supporting student learning. Studies show that students perform better in school if their parents are involved in their education. By becoming familiar with the curriculum, parents can determine what is being taught in the courses their daughters and sons are taking and what they are expected to learn. This awareness will enhance parents' ability to discuss their children's work with them, to communicate with teachers, and to ask relevant questions about their children's progress. Knowledge of the expectations in the various courses will also help parents to interpret teachers' comments on student progress and to work with teachers to improve their children's learning.

1. The word *parents* is used in this document to refer to parent(s) and guardian(s).

Effective ways in which parents can support their children's learning include attending parent–teacher interviews, participating in parent workshops, becoming involved in school council activities (including becoming a school council member), and encouraging students to complete their assignments at home. In addition to supporting regular school activities, parents may wish to provide their daughters and sons with opportunities to question and reflect on current affairs, including news about developments in various areas of technology.

Teachers

Teachers and students have complementary responsibilities. Teachers develop appropriate instructional strategies to help students achieve the curriculum expectations, as well as appropriate methods for assessing and evaluating student learning. Teachers also support students in developing the reading, writing, oral communication, and numeracy skills needed for success in their courses. Teachers bring enthusiasm and varied teaching and assessment approaches to the classroom, addressing different student needs and ensuring sound learning opportunities for every student.

Using a variety of instructional, assessment, and evaluation strategies, teachers provide numerous hands-on opportunities for students to develop and refine their problem-solving skills, critical and creative thinking skills, and communication skills, while discovering fundamental concepts through activities and projects, exploration, and research. The activities offered should enable students to relate and apply these concepts to the social, environmental, and economic conditions and concerns of the world in which they live. Opportunities to relate knowledge and skills to these wider contexts will motivate students to learn in a meaningful way and to become lifelong learners.

Teachers need to help students understand that problem solving of any kind often requires a considerable expenditure of time and energy and a good deal of perseverance. Teachers also need to encourage students to reason, to explore alternative solutions, and to take the risks necessary to become successful problem solvers.

Teachers are also responsible for ensuring the safety of students during classroom activities and for encouraging and motivating students to assume responsibility for their own safety and the safety of others. They must also ensure that students acquire the knowledge and skills needed for safe participation in all technological activities.

Principals

The principal works in partnership with teachers and parents to ensure that each student has access to the best possible educational experience. To support student learning, principals ensure that the Ontario curriculum is being properly implemented in all classrooms using a variety of instructional approaches. They also ensure that appropriate resources are made available for teachers and students. To enhance teaching and learning in all subjects, including technological education, principals promote learning teams and work with teachers to facilitate their participation in professional development activities. Principals are also responsible for ensuring that every student who has an Individual Education Plan (IEP) is receiving the modifications and/or accommodations described in his or her plan – in other words, for ensuring that the IEP is properly developed, implemented, and monitored.

Community Partnerships

Community partners in the area of technological education can be an important resource for schools and students. They can provide support for students in the classroom, and can be models of how the knowledge and skills acquired through the study of the curriculum relate to life beyond school. As mentors, they can enrich not only the educational experience of students, but also the life of the community. Schools can, for example, make arrangements with firms or other groups in the community to provide specialists in various areas and aspects of technology (e.g., engineers, technicians, technologists, tradespeople, or experts in construction, health care services, or green industries) to participate in in-class workshops for students based on topics, concepts, and skills from the curriculum. Such firms or groups may also be interested in working with schools to create opportunities for cooperative education and apprenticeships, in connection with the Ontario Youth Apprenticeship Program (OYAP).

Schools and school boards can play a role by coordinating efforts with community partners. They can involve colleges, universities, trade unions or professional organizations, local businesses, and community volunteers in supporting instruction and in promoting a focus on technological education in and outside the school. Postsecondary institutions and other community stakeholders can be included in events held at the school (such as parent education nights, technology skills competitions, and joint ventures), and school boards can collaborate with their community partners by providing educational opportunities within the community.

THE PROGRAM IN TECHNOLOGICAL EDUCATION

OVERVIEW OF THE PROGRAM

The technological education curriculum in Grades 9–12 encompasses ten subject areas, as follows:

Communications Technology
Computer Technology
Construction Technology
Green Industries
Hairstyling and Aesthetics
Health Care
Hospitality and Tourism
Manufacturing Technology
Technological Design
Transportation Technology

For Grade 9, one introductory broad-based technology course – Exploring Technologies (TIJ1O) – is outlined in this document. For Grade 10, one broad-based course is outlined for each of the ten subject areas listed above. Options for delivery of the Grade 9 and 10 courses are described on pages 10–13.

All courses offered in Grades 9 and 10 are "open" courses. Open courses, which comprise a set of expectations that are appropriate for all students, are designed to broaden students' knowledge and skills in subjects that reflect their interests, and to prepare them for active and rewarding participation in society. They are not designed with the specific requirements of universities, colleges, or the workplace in mind.

The technological education program in Grades 11 and 12 is designed to enable students to select courses that relate to their interests and that will prepare them for further study or work in the technological field of their choice. The Grade 11 and 12 curriculum offers university/college preparation, college preparation, workplace preparation, and open courses.

Although courses in technological education are optional, students should keep in mind that they can take any Grade 9–12 technological education course to fulfil the Group 3 additional compulsory credit requirement for the Ontario Secondary School Diploma.[2]

Technological education courses are well suited for inclusion in programs that lead to a diploma with a Specialist High Skills Major designation.

2. To meet the Group 3 additional compulsory credit requirement, students have the choice of earning one credit for a course in technological education (Grades 9 to 12) or computer studies (Grades 10 to 12), or one credit for an additional course in science (Grade 11 or 12), or one credit for a cooperative education course.

Technological Education Courses, Grades 9 and 10*				
Grade	**Course Name**	**Course Type**	**Course Code****	**Prerequisite**
9	Exploring Technologies†	Open	TIJ1O	None
10	Communications Technology	Open	TGJ2O	None
10	Computer Technology	Open	TEJ2O	None
10	Construction Technology	Open	TCJ2O	None
10	Green Industries	Open	THJ2O	None
10	Hairstyling and Aesthetics	Open	TXJ2O	None
10	Health Care	Open	TPJ2O	None
10	Hospitality and Tourism	Open	TFJ2O	None
10	Manufacturing Technology	Open	TMJ2O	None
10	Technological Design	Open	TDJ2O	None
10	Transportation Technology	Open	TTJ2O	None

* Each Grade 9 and 10 course has a credit value of 1. (Half-credit and multiple-credit courses may be developed according to conditions described in this document.)

** Course codes consist of five characters. The first three characters identify the subject; the fourth character identifies the grade (i.e., 1 and 2 refer to Grade 9 and Grade 10, respectively); and the fifth character identifies the type of course (i.e., O refers to "open").

† The Grade 9 course may be adapted to create an additional course or courses that focus on any one of the technological education subject areas listed on page 9. For more information, see page 13.

Options for Course Delivery in Grade 9

The Grade 9 course, Exploring Technologies, bridges the gap between the elementary science and technology program and the Grade 10 courses in the ten broad-based technological subject areas represented in the curriculum. Exploring Technologies is intended to introduce students to technological education in general, exposing them to a range of subject areas. Students in this course work on projects that encompass several different technological areas, using a range of equipment and resources suited to the various areas.

Schools that offer courses in numerous technological subject areas in Grades 10–12 may choose to develop more than one Exploring Technologies course on the basis of the expectations outlined in this document. Each course could cover a particular selection of subject areas. For example, "Exploring Technologies 1" might cover construction technology, technological design, and green industries; "Exploring Technologies 2" might address computer technology, manufacturing technology, and transportation technology; and "Exploring Technologies 3" could be dedicated to communications technology, hairstyling and aesthetics, health care, and hospitality and tourism.[3] Students select the course that best suits their interests. They may earn credit for only one such course.

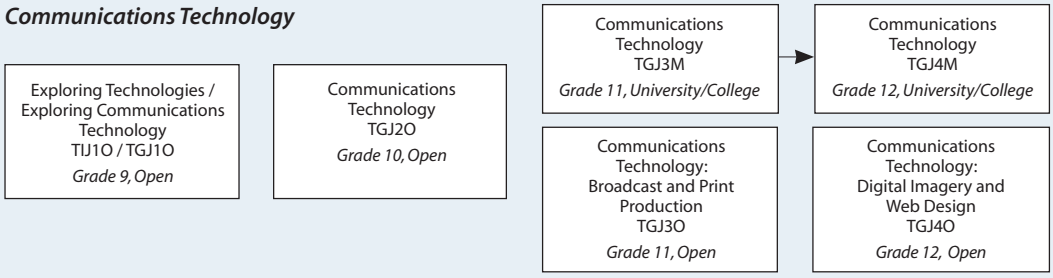
Some schools may find a "shop rounds" approach to the delivery of Exploring Technologies effective. In this approach, students focus on particular subject areas for a few weeks at a time throughout a semester or school year (e.g., on health care for three weeks, green industries for three weeks, and so on).

3. Schools may add a sixth character to the course code specified in this document to indicate additional information. In the example above, the three alternative Exploring Technologies courses could be identified as TIJ1O**1**, TIJ1O**2**, and TIJ1O**3**, respectively.

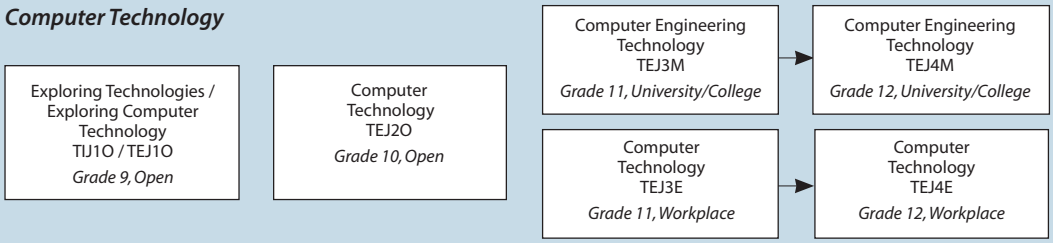
Prerequisite Charts for Technological Education, Grades 9–12

These charts map out all the courses in the discipline and show the links between courses and the possible prerequisites for them. They do not attempt to depict all possible movements from course to course.

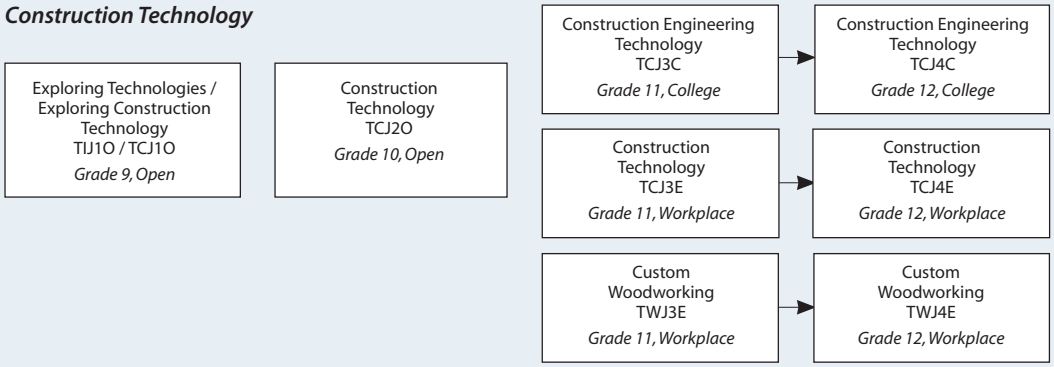
Communications Technology



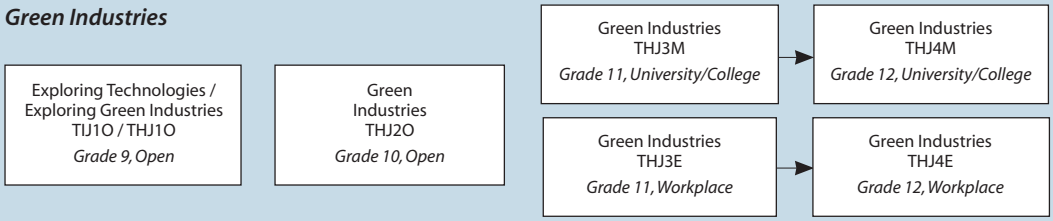
Computer Technology



Construction Technology



Green Industries

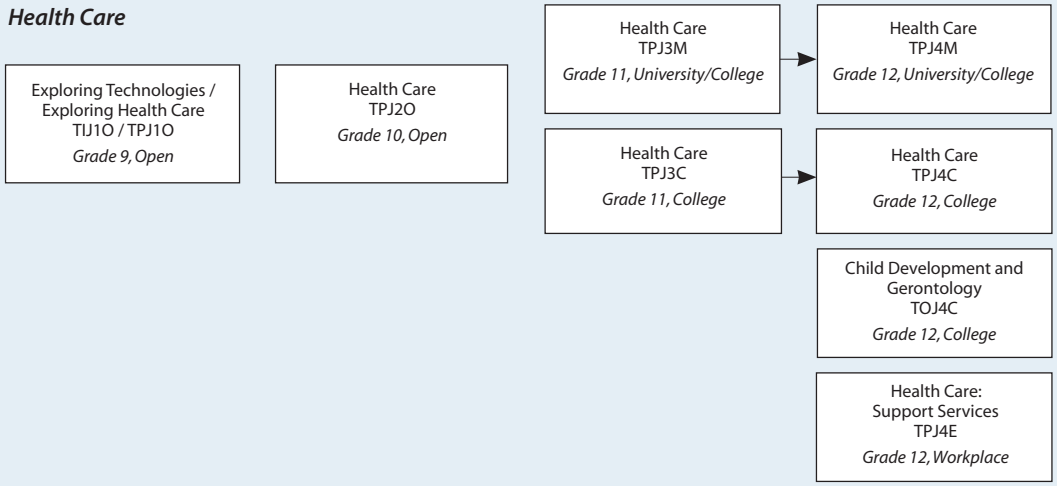


Hairstyling and Aesthetics

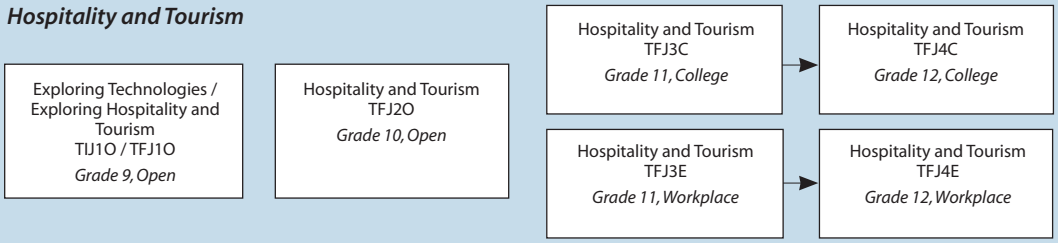
(continued)

Prerequisite Charts for Technological Education, Grades 9–12 *(continued)*

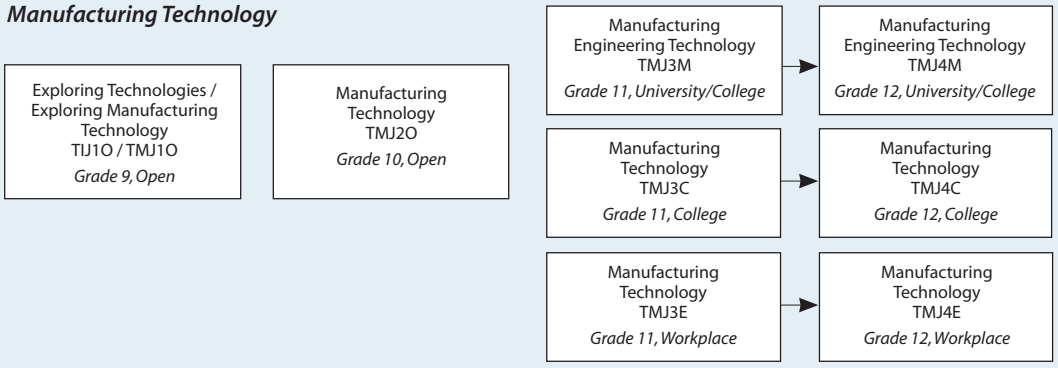
Health Care



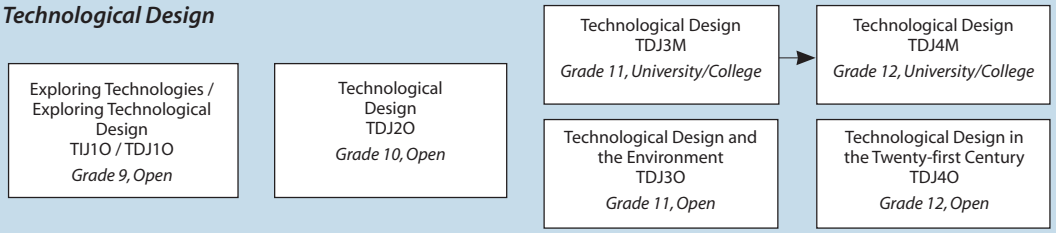
Hospitality and Tourism



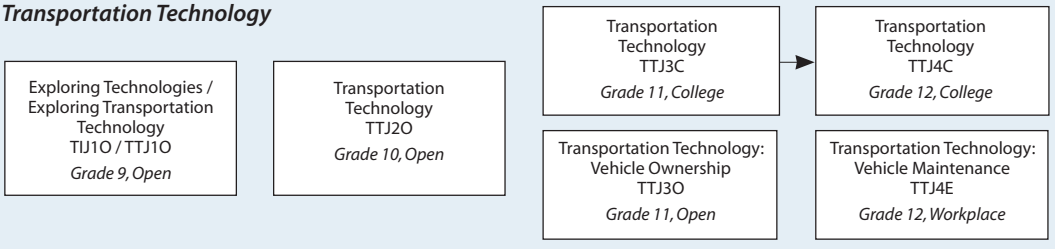
Manufacturing Technology



Technological Design



Transportation Technology



Schools may also offer one or more additional broad-based Grade 9 courses, each dedicated to one particular technological subject area. The additional course(s) must be developed on the basis of the expectations outlined in this document for Exploring Technologies, and must be assigned a specified name and code (see the list on pp. 43–44). Students may take, and earn credit for, more than one technological education course in Grade 9 (up to one credit for TIJ1O and up to one credit for each additional Grade 9 course successfully completed). It is recommended that students successfully complete Exploring Technologies (TIJ1O) before taking any additional Grade 9 broad-based subject-area course (or courses).

The Grade 9 course may be delivered as a half-credit course (see p. 14), but may not be planned as a multiple-credit course or an emphasis course.

Options for Course Delivery in Grade 10

Multiple-Credit Courses

In certain cases, courses in Grade 10 may be planned for up to 330 hours of scheduled instructional time (for which the student may earn a maximum of 3 credits). This additional instructional time allows for the practice and refinement of skills. The skills students develop in multiple-credit courses should reflect current industry practices and standards.

Instructional time may be increased by increments of 55 hours. For each additional 55 hours, students earn an additional half-credit, to a maximum of three credits. The number of additional credits and the nature of the skills to be practised and refined during the additional instructional time must be established before the start of the course.

In the event that a student is unable to complete the planned number of hours for a multiple-credit course, credit should be awarded on the basis of the actual number of hours the student has completed, provided that the student has demonstrated achievement of all of the specific expectations in the course and that his or her achievement of all of the overall expectations has been evaluated.

Emphasis Courses

Any Grade 10 broad-based technological education course may be developed to emphasize a particular area of the subject (that is, an area related to a particular sector or particular occupations connected with the subject). For example, a manufacturing technology course could be developed to emphasize welding, or a transportation technology course could be developed to emphasize auto service. However, an emphasis course must not entirely exclude other areas of the subject that relate to different sectors or occupations.

Regardless of the area emphasized in a course, students must be given the opportunity to achieve all of the expectations of the course outlined in this document.

In school calendars, the area of emphasis of a Grade 10 course may be identified by adding a descriptive word or phrase to the course title and an additional sentence to the course description provided in this document. The course code for an emphasis course is the same as the code provided in this document for the original course, but may have a sixth character added for purposes of identification (see footnote 3 on p. 10).

Half-Credit Courses

The courses outlined in the technological education curriculum documents are designed as full-credit courses. However, *with the exception of the Grade 12 university/college preparation courses*, they may also be delivered as half-credit courses.

Half-credit courses, which require a minimum of fifty-five hours of scheduled instructional time, must adhere to the following conditions:

- The two half-credit courses created from a full course must together contain all of the expectations of the full course. The expectations for each half-credit course must be drawn from all strands of the full course and must be divided in a manner that best enables students to achieve the required knowledge and skills in the allotted time.
- A course that is a prerequisite for another course in the secondary curriculum may be offered as two half-credit courses, but students must successfully complete both parts of the course to fulfil the prerequisite. (Students are not required to complete both parts unless the course is a prerequisite for another course they wish to take.)
- 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.

Boards will ensure that all half-credit courses comply with the conditions described above, and will report all half-credit courses to the ministry annually in the School October Report.

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.

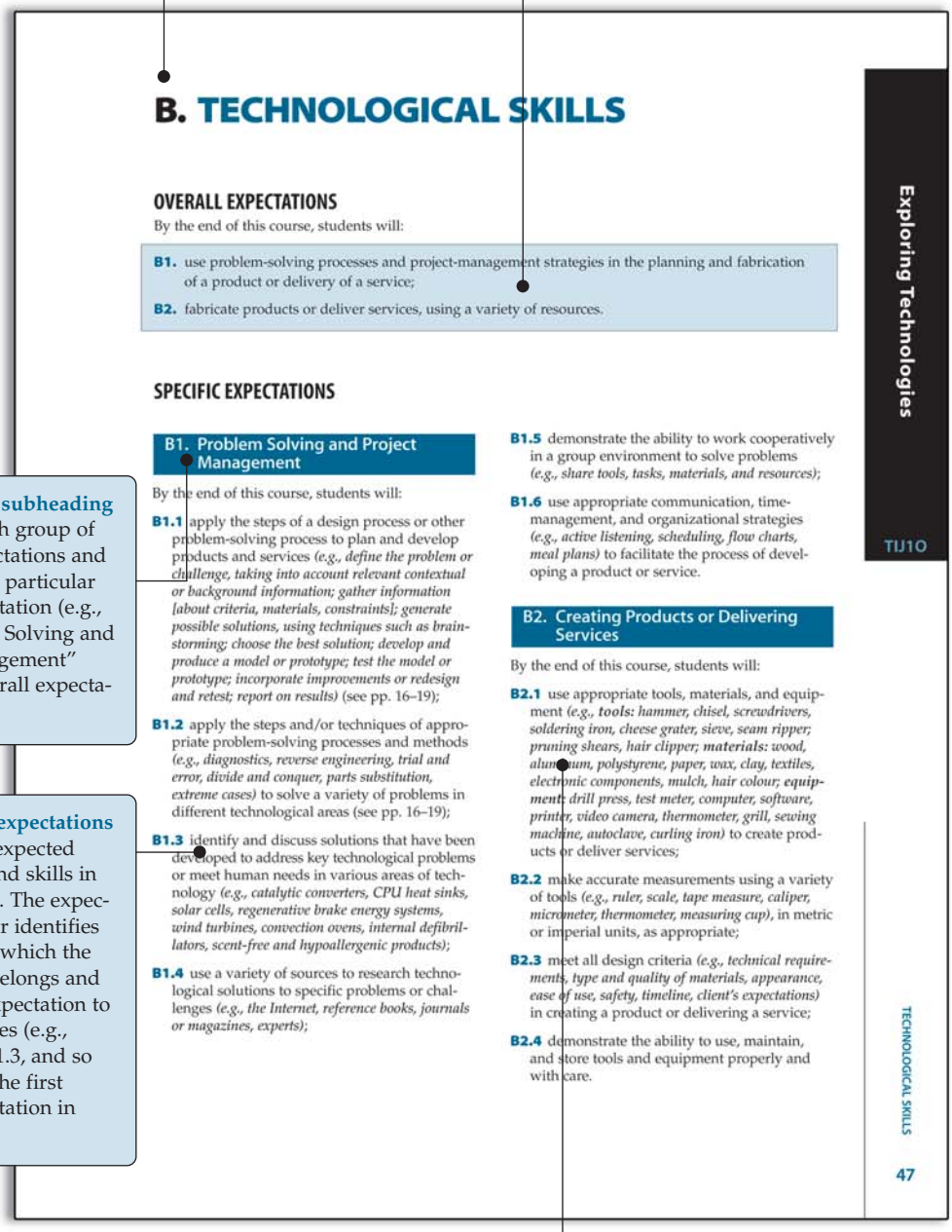
Two sets of expectations are listed for each strand, or broad curriculum area, of each course. (The strands are numbered A, B, C, D, and, in some courses, E.)

- 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 are grouped under numbered subheadings, each of which indicates the strand and the overall expectation to which the subgrouping of specific expectations corresponds (e.g., "B2" indicates that the group relates to overall expectation 2 in strand B). The subheadings may serve as a guide for teachers as they plan learning activities for their students.

The organization of expectations into strands and subgroupings is not meant to imply that the expectations in any one strand or group are achieved independently of the expectations in the other strands or groups. The strands and subgroupings are used merely to help teachers focus on particular aspects of knowledge and skills as they develop various learning activities for their students. The concepts, content, and skills identified in the different strands of each course should, wherever appropriate, be integrated in instruction throughout the course.

Technological education courses are typically organized into four **strands**, numbered A, B, C, and D.

The **overall expectations** describe in general terms the knowledge and skills students are expected to demonstrate by the end of each course. Two or more overall expectations are provided for each strand in every course. The numbering of overall expectations indicates the strand to which they belong (e.g., B1 and B2 are the overall expectations for strand B).



B. TECHNOLOGICAL SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. use problem-solving processes and project-management strategies in the planning and fabrication of a product or delivery of a service;

B2. fabricate products or deliver services, using a variety of resources.

SPECIFIC EXPECTATIONS

B1. Problem Solving and Project Management

By the end of this course, students will:

B1.1 apply the steps of a design process or other problem-solving process to plan and develop products and services *(e.g., define the problem or challenge, taking into account relevant contextual or background information; gather information [about criteria, materials, constraints]; generate possible solutions, using techniques such as brainstorming; choose the best solution; develop and produce a model or prototype; test the model or prototype; incorporate improvements or redesign and retest; report on results)* (see pp. 16–19);

B1.2 apply the steps and/or techniques of appropriate problem-solving processes and methods *(e.g., diagnostics, reverse engineering, trial and error, divide and conquer, parts substitution, extreme cases)* to solve a variety of problems in different technological areas (see pp. 16–19);

B1.3 identify and discuss solutions that have been developed to address key technological problems or meet human needs in various areas of technology *(e.g., catalytic converters, CPU heat sinks, solar cells, regenerative brake energy systems, wind turbines, convection ovens, internal defibrillators, scent-free and hypoallergenic products)*;

B1.4 use a variety of sources to research technological solutions to specific problems or challenges *(e.g., the Internet, reference books, journals or magazines, experts)*;

B1.5 demonstrate the ability to work cooperatively in a group environment to solve problems *(e.g., share tools, tasks, materials, and resources)*;

B1.6 use appropriate communication, time-management, and organizational strategies *(e.g., active listening, scheduling, flow charts, meal plans)* to facilitate the process of developing a product or service.

B2. Creating Products or Delivering Services

By the end of this course, students will:

B2.1 use appropriate tools, materials, and equipment *(e.g., **tools:** hammer, chisel, screwdrivers, soldering iron, cheese grater, sieve, seam ripper; pruning shears, hair clipper; **materials:** wood, aluminum, polystyrene, paper, wax, clay, textiles, electronic components, mulch, hair colour; **equipment:** drill press, test meter, computer, software, printer, video camera, thermometer, grill, sewing machine, autoclave, curling iron)* to create products or deliver services;

B2.2 make accurate measurements using a variety of tools *(e.g., ruler, scale, tape measure, caliper, micrometer, thermometer, measuring cup)*, in metric or imperial units, as appropriate;

B2.3 meet all design criteria *(e.g., technical requirements, type and quality of materials, appearance, ease of use, safety, timeline, client's expectations)* in creating a product or delivering a service;

B2.4 demonstrate the ability to use, maintain, and store tools and equipment properly and with care.

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A **numbered subheading** identifies each group of specific expectations and relates to one particular overall expectation (e.g., "B1. Problem Solving and Project Management" relates to overall expectation B1).

The **specific expectations** describe the expected knowledge and skills in greater detail. The expectation number identifies the strand to which the expectation belongs and the overall expectation to which it relates (e.g., B1.1, B1.2, B1.3, and so on, relate to the first overall expectation in strand B).

The **examples** help to clarify the requirement specified in the expectation and to suggest its intended depth and level of complexity. The examples are illustrations only, not requirements. They appear in parentheses and are set in italics.

Many of the specific expectations are accompanied by examples, which are given in parentheses and italicized. These examples are meant to illustrate the kind of knowledge or skill, the specific area of learning, the depth of learning, and/or the level of complexity that the expectation entails. In addition, the examples provided within a broad-based technological education course may collectively reflect the range of areas represented within a given subject (e.g., a construction technology course may include examples that are applicable to plumbing, electrical/network cabling, masonry, heating and cooling, and carpentry).

The examples are intended as a guide for teachers rather than as an exhaustive or mandatory list. Teachers can choose to use the examples that are appropriate for their classrooms or they may develop their own approaches that reflect a similar level of complexity. Whatever the specific ways in which the requirements outlined in the expectations are implemented in the classroom, they must, wherever possible, be inclusive and reflect the diversity of the student population and the population of the province.

STRANDS IN THE TECHNOLOGICAL EDUCATION CURRICULUM

The overall and specific expectations for each course in the technological education curriculum are typically organized in four distinct but related strands. As students move up through the grades, the expectations within these strands will increase in complexity and depth. These strands are as follows:

Fundamentals: Students develop foundational knowledge and skills related to the design and fabrication of products or the provision of services in the particular broad-based technological subject area.

Skills: Students develop the technological skills required for responding to a variety of practical challenges.

Technology, the Environment, and Society: Students develop an understanding of the interrelationship between the technology or industry sector and the environment, and between the technology and various aspects of society. (In subject areas that relate to services, this strand is entitled Industry Practices, the Environment, and Society.)

Professional Practice and Career Opportunities: Students develop an understanding of health and safety standards in the industry, professional concerns and issues, and the Essential Skills and work habits valued in the sector, and explore career opportunities and the education and training required for them.

PROBLEM SOLVING IN TECHNOLOGICAL EDUCATION

An approach to learning that emphasizes problem solving is the best way to prepare students for the challenges they will face in the world beyond school. In the workplace, projects or tasks may not always be clearly defined or have prescribed solutions. Students who have a strong background in problem solving will be more confident and better equipped to address new challenges in a variety of contexts.

Learning through problem solving will help students appreciate that all challenges – whether large or small, complex or simple – are most effectively resolved when approached systematically, using a simple method or a more comprehensive process, depending on the nature of the problem.

The range of challenges students encounter in technological education is wide and varied. At one end are simple problems for which there is likely to be only one solution – for example, substituting a part to fix an obvious fault. At the other end are complex challenges – for example, devising a solution to an identified human need – for which there could be various different solutions and which call for a detailed process that may involve consultations with stakeholders to clearly define the problem and determine criteria for its solution, and the design and testing of several potential solutions. In many cases, the nature of the problem, and the problem-solving process required to solve it, fall somewhere between these two extremes.

Technological education teachers can guide students through problem solving by helping them understand the nature and scope of a problem and the type of approach or method best suited to address it. They can also remind students that there is often more than one solution, give them the freedom to explore ideas, and encourage them to retrace steps and persist in their efforts when they encounter obstacles.

Problem-Solving Methods and Approaches

Problem-solving processes share at least some of a number of systematic steps – for example, identifying the problem, analysing the situation, considering possible solutions, selecting the best solution, testing and evaluating the effectiveness of the solution, and reviewing or repeating steps as necessary to improve the solution. Among the various problem-solving methods and approaches that may be employed to address the range of problems students will encounter in technological education are those listed below. This list is not comprehensive, and may be supplemented by various other methods in the classroom.

Parts Substitution

Perhaps the most basic of all the problem-solving methods, "parts substitution" simply requires that parts be substituted until the problem is solved. Although it is not the most scientific method of problem solving, there may be no other alternative if tests do not indicate what could be causing the problem.

Diagnostics

An example of a diagnostic problem-solving method is troubleshooting an engine fault in an automobile. After identifying the general problem, the technician would run tests to pinpoint the fault. The test results would be used either as a guide for further testing or for replacement of a part, which would also need to be tested. This process continues until the solution is found and the car is running properly.

Reverse Engineering

Reverse engineering is the process of discovering the technological principles underlying the design of a device by taking the device apart, or carefully tracing its workings or its circuitry. It is useful when students are attempting to build something for which they have no formal drawings or schematics.

Divide and Conquer

"Divide and conquer" is the technique of breaking down a problem into subproblems, then breaking the subproblems down even further until each of them is simple enough to be solved. Divide and conquer may be applied to allow groups of students to tackle subproblems of a larger problem, or when a problem is so large that its solution cannot be visualized without breaking it down into smaller components.

Extreme Cases

Considering "extreme cases" – envisioning the problem in a greatly exaggerated or greatly simplified form, or testing using an extreme condition – can often help to pinpoint a problem. An example of the extreme-case method is purposely inputting an extremely high number to test a computer program.

Trial and Error

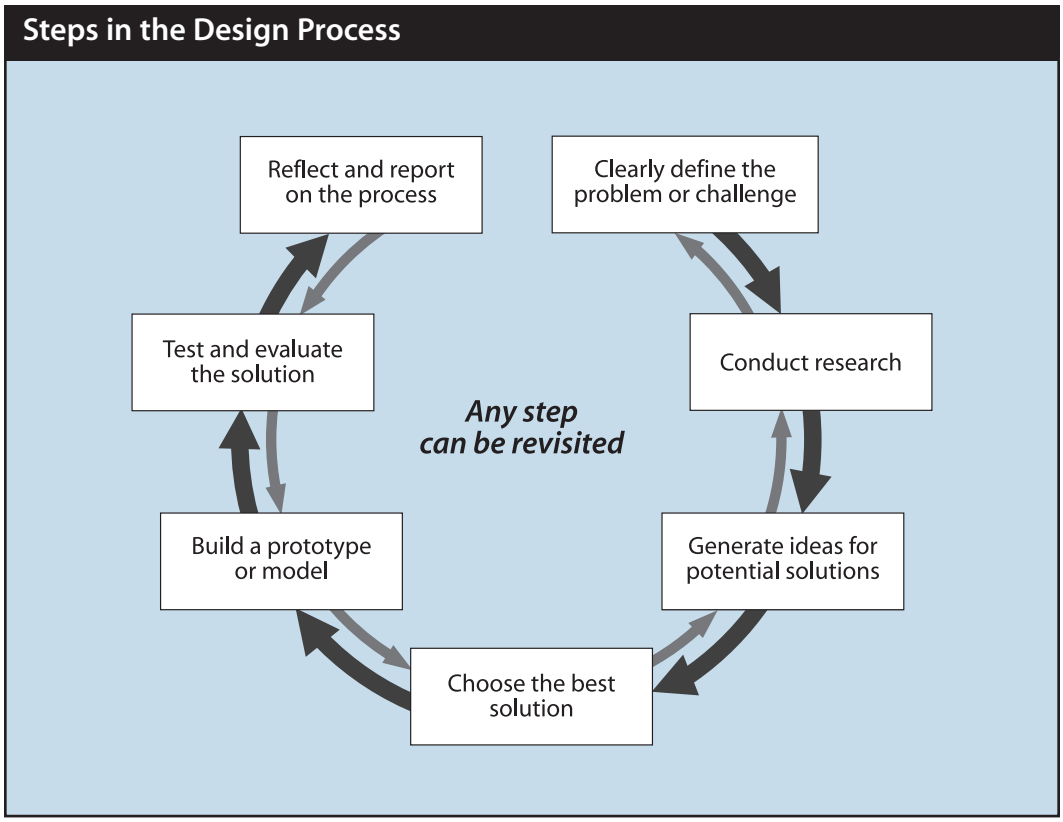
The trial-and-error method involves trying different approaches until a solution is found. It is often used as a last resort when other methods have been exhausted.

The Design Process

In many technological fields, open-ended problem-solving processes that involve the full planning and development of products or services to meet identified needs are often referred to as the "design process". A design process involves a sequence of steps, such as the following:

- Analyse the context and background, and clearly define the problem or challenge.
- Conduct research to determine design criteria, financial or other constraints, and availability of materials.
- Generate ideas for potential solutions, using processes such as brainstorming and sketching.
- Choose the best solution.
- Build a prototype or model.
- Test and evaluate the solution.
- Repeat steps as necessary to modify the design or correct faults.
- Reflect and report on the process.

Steps in the Design Process



Although processes such as this involve a framework of sequential steps, they are typically iterative processes that may require a retracing of steps, diversions to solve specific problems along the way, or even a return to the start of the process if it becomes clear that the situation needs to be clarified and the problem redefined. Problem solvers soon discover that the process calls for an open mind, the freedom to be creative, and a great deal of patience and persistence.

ASSESSMENT AND EVALUATION OF STUDENT ACHIEVEMENT

BASIC CONSIDERATIONS

The primary purpose of assessment and evaluation is to improve student learning. Information gathered through assessment helps teachers to determine students' strengths and weaknesses in their achievement of the curriculum expectations in each course. This information also serves to guide teachers in adapting curriculum and instructional approaches to students' needs and in assessing the overall effectiveness of programs and classroom practices.

Assessment is the process of gathering information from a variety of sources (including assignments, day-to-day observations, conversations or conferences, demonstrations, projects, performances, and tests) that accurately reflects how well a student is achieving the curriculum expectations in a course. As part of assessment, teachers provide students with descriptive feedback that guides their efforts towards improvement. Evaluation refers to the process of judging the quality of student work on the basis of established criteria, and assigning a value to represent that quality.

Assessment and evaluation will be based on the provincial curriculum expectations and the achievement levels outlined in this document.

In order to ensure that assessment and evaluation are valid and reliable, and that they lead to the improvement of student learning, teachers must use assessment and evaluation strategies that:

- address both what students learn and how well they learn;
- are based both on the categories of knowledge and skills and on the achievement level descriptions given in the achievement chart on pages 24–25;
- are varied in nature, administered over a period of time, and designed to provide opportunities for students to demonstrate the full range of their learning;
- are appropriate for the learning activities used, the purposes of instruction, and the needs and experiences of the students;

- are fair to all students;
- accommodate the needs of students with special education needs, consistent with the strategies outlined in their Individual Education Plan;
- accommodate the needs of students who are learning the language of instruction (English or French);
- ensure that each student is given clear directions for improvement;
- promote students' ability to assess their own learning and to set specific goals;
- include the use of samples of students' work that provide evidence of their achievement;
- are communicated clearly to students and parents at the beginning of the course or the school term and at other appropriate points throughout the school year.

Evaluation of Achievement of Overall Expectations

All curriculum expectations must be accounted for in instruction, but evaluation focuses on students' achievement of the overall expectations. A student's achievement of the overall expectations is evaluated on the basis of his or her achievement of related specific expectations. The overall expectations are broad in nature, and the specific expectations define the particular content or scope of the knowledge and skills referred to in the overall expectations. Teachers will use their professional judgement to determine which specific expectations should be used to evaluate achievement of the overall expectations, and which ones will be covered in instruction and assessment (e.g., through direct observation) but not necessarily evaluated.

Levels of Achievement

The characteristics given in the achievement chart (pp. 24–25) for level 3 represent the "provincial standard" for achievement of the expectations in a course. 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 shaded column of the achievement chart, headed "70–79% (Level 3)". Parents of students achieving at level 3 can be confident that their children will be prepared for work in subsequent courses.

Level 1 identifies achievement that falls much below the provincial standard, while still reflecting a passing grade. Level 2 identifies achievement that approaches the standard. Level 4 identifies achievement that surpasses the standard. It should be noted that achievement at level 4 does not mean that the student has achieved expectations beyond those specified for a particular course. It indicates that the student has achieved all or almost all of the expectations for that course, and that he or she demonstrates the ability to use the specified knowledge and skills in more sophisticated ways than a student achieving at level 3.

THE ACHIEVEMENT CHART FOR TECHNOLOGICAL EDUCATION

The achievement chart that follows identifies four categories of knowledge and skills in technological education. The achievement chart is a standard province-wide guide to be used by teachers. It enables teachers to make judgements about student work that are based on clear performance standards and on a body of evidence collected over time.

The purpose of the achievement chart is to:

- provide a common framework that encompasses all curriculum expectations for all courses outlined in this document;
- guide the development of high-quality assessment tasks and tools (including rubrics);
- help teachers to plan instruction for learning;
- assist teachers in providing meaningful feedback to students;
- provide various categories and criteria with which to assess and evaluate students' learning.

Categories of Knowledge and Skills

The categories, defined by clear criteria, represent four broad areas of knowledge and skills within which the subject expectations for any given course are organized. The four categories should be considered as interrelated, reflecting the wholeness and interconnectedness of learning.

The categories of knowledge and skills are described as follows:

Knowledge and Understanding. Subject-specific content acquired in each course (knowledge), and the comprehension of its meaning and significance (understanding).

Thinking. The use of critical and creative thinking skills and/or processes, as follows:

- planning skills (e.g., identifying the problem, selecting strategies and resources, scheduling)
- processing skills (e.g., analysing and interpreting information, reasoning, generating and evaluating solutions, forming conclusions)
- critical/creative thinking processes (e.g., problem-solving, design, and decision-making processes)

Communication. The conveying of meaning through various forms, as follows:

- oral (e.g., role play, discussion, presentation)
- written (e.g., design briefs, work orders, technical reports)
- visual (e.g., technical drawings, flow charts, graphics)

Application. The use of knowledge and skills to make connections within and between various contexts.

Teachers will ensure that student work is assessed and/or evaluated in a balanced manner with respect to the four categories, and that achievement of particular expectations is considered within the appropriate categories.

Criteria

Within each category in the achievement chart, criteria are provided that are subsets of the knowledge and skills that define each category. For example, in Knowledge and Understanding, the criteria are "knowledge of content (e.g., facts, equipment, terminology, materials)" and "understanding of content (e.g., procedures, technological concepts, processes, industry standards)". The criteria identify the aspects of student performance that are assessed and/or evaluated, and serve as guides to what to look for.

Descriptors

A "descriptor" indicates the characteristic of the student's performance, with respect to a particular criterion, on which assessment or evaluation is focused. In the achievement chart, *effectiveness* is the descriptor used for each criterion in the Thinking, Communication, and Application categories. What constitutes effectiveness in any given performance task will vary with the particular criterion being considered. Assessment of effectiveness may therefore focus on a quality such as appropriateness, clarity, accuracy, precision, logic, relevance, significance, fluency, flexibility, depth, or breadth, as appropriate for the particular criterion. For example, in the Thinking category, assessment of effectiveness might focus on the degree of relevance or depth apparent in an analysis; in the Communication category, on clarity of expression or logical organization of information and ideas; or in the Application category, on appropriateness or breadth in the making of connections. Similarly, in the Knowledge and Understanding category, assessment of knowledge might focus on accuracy, and assessment of understanding might focus on the depth of an explanation. Descriptors help teachers to focus their assessment and evaluation on specific knowledge and skills for each category and criterion, and help students to better understand exactly what is being assessed and evaluated.

Qualifiers

A specific "qualifier" is used to define each of the four levels of achievement – that is, *limited* for level 1, *some* for level 2, *considerable* for level 3, and a *high degree* or *thorough* for level 4. A qualifier is used along with a descriptor to produce a description of performance at a particular level. For example, the description of a student's performance at level 3 with respect to the first criterion in the Thinking category would be: "the student uses planning skills with *considerable* effectiveness".

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. In all of their courses, students should be given numerous and varied opportunities to demonstrate the full extent of their achievement of the curriculum expectations across all four categories of knowledge and skills.

ACHIEVEMENT CHART: TECHNOLOGICAL EDUCATION, GRADES 9–12

Categories	50–59% (Level 1)	60–69% (Level 2)	70–79% (Level 3)	80–100% (Level 4)
Knowledge and Understanding – Subject-specific content acquired in each course (knowledge), and the comprehension of its meaning and significance (understanding)				
	The student:			
Knowledge of content *(e.g., facts, equipment, terminology, materials)*	demonstrates limited knowledge of content	demonstrates some knowledge of content	demonstrates considerable knowledge of content	demonstrates thorough knowledge of content
Understanding of content *(e.g., procedures, technological concepts, processes, industry standards)*	demonstrates limited understanding of content	demonstrates some understanding of content	demonstrates considerable understanding of content	demonstrates thorough understanding of content
Thinking – The use of critical and creative thinking skills and/or processes				
	The student:			
Use of planning skills *(e.g., identifying the problem, selecting strategies and resources, scheduling)*	uses planning skills with limited effectiveness	uses planning skills with some effectiveness	uses planning skills with considerable effectiveness	uses planning skills with a high degree of effectiveness
Use of processing skills *(e.g., analysing and interpreting information, reasoning, generating and evaluating solutions, forming conclusions)*	uses processing skills with limited effectiveness	uses processing skills with some effectiveness	uses processing skills with considerable effectiveness	uses processing skills with a high degree of effectiveness
Use of critical/creative thinking processes *(e.g., problem-solving, design, and decision-making processes)*	uses critical/creative thinking processes with limited effectiveness	uses critical/creative thinking processes with some effectiveness	uses critical/creative thinking processes with considerable effectiveness	uses critical/creative thinking processes with a high degree of effectiveness

Categories	50–59% (Level 1)	60–69% (Level 2)	70–79% (Level 3)	80–100% (Level 4)
Communication – The conveying of meaning through various forms				
	The student:			
Expression and organization of ideas and information *(e.g., clear expression, logical organization)* **in oral, visual, and written forms**	expresses and organizes ideas and information with limited effectiveness	expresses and organizes ideas and information with some effectiveness	expresses and organizes ideas and information with considerable effectiveness	expresses and organizes ideas and information with a high degree of effectiveness
Communication for different audiences in oral, visual, and written forms	communicates for different audiences and purposes with limited effectiveness	communicates for different audiences and purposes with some effectiveness	communicates for different audiences and purposes with considerable effectiveness	communicates for different audiences and purposes with a high degree of effectiveness
Use of conventions *(e.g., standards/symbols, units of measurement, acronyms)*, **vocabulary, and terminology of the discipline in oral, visual, and written forms**	uses conventions, vocabulary, and terminology of the discipline with limited effectiveness	uses conventions, vocabulary, and terminology of the discipline with some effectiveness	uses conventions, vocabulary, and terminology of the discipline with considerable effectiveness	uses conventions, vocabulary, and terminology of the discipline with a high degree of effectiveness
Application – The use of knowledge and skills to make connections within and between various contexts				
	The student:			
Application of knowledge and skills *(e.g., concepts, processes, use of equipment and technology)* **in familiar contexts**	applies knowledge and skills in familiar contexts with limited effectiveness	applies knowledge and skills in familiar contexts with some effectiveness	applies knowledge and skills in familiar contexts with considerable effectiveness	applies knowledge and skills in familiar contexts with a high degree of effectiveness
Transfer of knowledge and skills *(e.g., concepts, processes, use of equipment and technology)* **to new contexts**	transfers knowledge and skills to new contexts with limited effectiveness	transfers knowledge and skills to new contexts with some effectiveness	transfers knowledge and skills to new contexts with considerable effectiveness	transfers knowledge and skills to new contexts with a high degree of effectiveness
Making connections within and between various contexts *(e.g., between disciplines; between technology, the environment, and society; between school and future opportunities)*	makes connections within and between various contexts with limited effectiveness	makes connections within and between various contexts with some effectiveness	makes connections within and between various contexts with considerable effectiveness	makes connections within and between various contexts with a high degree of effectiveness

Note: A student whose achievement is below 50% at the end of a course will not obtain a credit for the course.

EVALUATION AND REPORTING OF STUDENT ACHIEVEMENT

Student achievement must be communicated formally to students and parents by means of the Provincial Report Card, Grades 9–12. The report card provides a record of the student's achievement of the curriculum expectations in every course, at particular points in the school year or semester, in the form of a percentage grade. The percentage grade represents the quality of the student's overall achievement of the expectations for the course and reflects the corresponding level of achievement as described in the achievement chart for the discipline.

A final grade is recorded for every course, and a credit is granted and recorded for every course in which the student's grade is 50% or higher. The final grade for each course in Grades 9 to 12 will be determined as follows:

- Seventy per cent of the grade will be based on evaluations conducted throughout the course. This portion of the grade should reflect the student's most consistent level of achievement throughout the course, although special consideration should be given to more recent evidence of achievement.
- Thirty per cent of the grade will be based on a final evaluation in the form of an examination, performance, essay, and/or other method of evaluation suitable to the course content and administered towards the end of the course.

REPORTING ON DEMONSTRATED LEARNING SKILLS

The report card provides a record of the learning skills demonstrated by the student in every course, in the following five categories: Works Independently, Teamwork, Organization, Work Habits, and Initiative. The learning skills are evaluated using a four-point scale (E–Excellent, G–Good, S–Satisfactory, N–Needs Improvement). The separate evaluation and reporting of the learning skills in these five areas reflect their critical role in students' achievement of the curriculum expectations. To the extent possible, the evaluation of learning skills, apart from any that may be included as part of a curriculum expectation in a course, should not be considered in the determination of percentage grades.

SOME CONSIDERATIONS FOR PROGRAM PLANNING

Teachers who are planning a program in technological education must take into account considerations in a number of important areas, including those discussed below.

INSTRUCTIONAL APPROACHES

Technological education involves knowing and doing, and teaching and learning approaches should address both areas. Teachers should use projects as a major means of achieving course expectations, and students should be provided with a combination of information and experiences 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 learn best when they are engaged in learning in a variety of ways. Technological education courses lend themselves to a wide range of approaches in that they require students to discuss issues, solve problems, plan solutions, participate in development of solutions, conduct research, think critically, and work cooperatively. When students are engaged in active and experiential learning strategies, they tend to retain knowledge for longer periods and to develop, acquire, and integrate key skills more completely.

Programs in technological education should involve an open, collaborative, activity-based approach to teaching that accommodates students' interests, aspirations, and learning styles. Activities should be designed to include both individual and team approaches, as technological projects in the workplace often require individuals to work collaboratively while undertaking a variety of roles and tasks. Students should be given opportunities to work both independently and with teacher direction, and to learn through the study of examples followed by practice. There is no single correct way to teach or to learn, and the strategies used in the classroom should vary according to the curriculum expectations and the needs of the students. Problem solving and/or the design process should be an integral part of all broad-based technological education. Teachers should work collaboratively with colleagues to plan and deliver the technological education curriculum. Individual teachers can contribute their expertise in particular areas of technology to ensure the successful implementation of the curriculum.

Some of the teaching and learning strategies that are suitable to material taught in technological education employ scaffolding. Scaffolding is an instructional approach that involves breaking down tasks so that students can concentrate on specific, manageable objectives and gradually build understanding and skill, with the aid of modelling by the teacher and ample opportunity for practice. Scaffolding provides students with a supportive structure within which to learn.

Some of the concepts taught in technological education involve abstract thinking, which can be difficult for many students. Role playing is an approach teachers can employ to help students internalize new concepts. Learning processes that include opportunities for physical activity by students can lead to better understanding and longer retention of concepts. The use of kinesthetic learning can be an effective way to adapt technological education to the varied learning styles that students may demonstrate.

When students work collaboratively they often accomplish more than when they work individually. Group activities, when used in a structured way, can enhance learning and foster positive attitudes. When working in a team, each student should have a specific role and be actively involved in the task. It is important to give students opportunities to take on different roles, from one project to another or in the course of a large project.

Students' attitudes towards technological education can have a significant effect on their achievement of expectations. Teaching methods and learning activities that encourage students to recognize the value and relevance of what they are learning for work and their lives beyond school will go a long way towards motivating students to work and learn effectively.

The study of current events related to technologies in various industries, including emerging technologies, should inform the technological education curriculum, enhancing both the relevance and the immediacy of the program. Discussion of current events related to various technologies and inclusion of these topics in daily lessons will stimulate students' interest and curiosity and also help them connect what they are learning in class with real-world events or situations. The study of events in industry sectors and technological developments in the world needs to be thought of not as a separate topic removed from the program but as an effective instructional strategy for implementing many of the expectations found in the curriculum.

HEALTH AND SAFETY IN TECHNOLOGICAL EDUCATION

Health and safety is of paramount importance in technological education. In every course, students must be made aware that health and safety is everyone's responsibility – at home, at school, and in the workplace. Before using any piece of equipment or any tool, students must be able to demonstrate knowledge of how the equipment or tool works and of the procedures they must follow to ensure its safe use. Personal protective gear must be worn as required.

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

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

Teachers should make use of all available and relevant resources to make students sufficiently aware of the importance of health and safety. These resources include:

- Live Safe! Work Smart! – website and related resources
- Passport to Safety – website and related resources
- 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 Construction Safety Association of Ontario (CSAO), the Ontario Service Safety Alliance (OSSA), the Transportation Health and Safety Association of Ontario (THSAO), the Electrical & Utilities Safety Association (E&USA), the Workers Health & Safety Centre (WHSC), and the Occupational Health Clinics for Ontario Workers (OHCOW)

Teachers are responsible for ensuring the safety of students during technology lab, shop, and classroom activities. Health and safety issues must also be addressed when learning involves cooperative education and other workplace experiences (see p. 39). Teachers need to encourage and motivate students to assume responsibility for their own safety and the safety of others, and they must help students develop the knowledge and skills needed for safe participation in all technology-related activities. For these reasons, teachers must model safe practices at all times and communicate safety expectations to students in accordance with school board policies and procedures, Ministry of Education policies, and Ministry of Labour regulations.

THE ONTARIO SKILLS PASSPORT AND ESSENTIAL SKILLS

Teachers planning programs in technological education need to be aware of the purpose and benefits of the Ontario Skills Passport (OSP). The OSP is a bilingual web-based resource that enhances the relevance of classroom learning for students and strengthens school–work connections. The OSP provides clear descriptions of Essential Skills such as Reading Text, Writing, Computer Use, Measurement and Calculation, and Problem Solving and includes an extensive database of occupation-specific workplace tasks that illustrate how workers use these skills on the job. The Essential Skills are transferable, in

that they are used in virtually all occupations. The OSP also includes descriptions of important work habits, such as working safely, being reliable, and providing excellent customer service. The OSP is designed to help employers assess and record students' demonstration of these skills and work habits during their cooperative education placements. Students can use the OSP to assess, practise, and build their Essential Skills and work habits and transfer them to a job or further education or training.

The skills described in the OSP are the Essential Skills that the Government of Canada and other national and international agencies have identified and validated, through extensive research, as the skills needed for work, learning, and life. These Essential Skills provide the foundation for learning all other skills and enable people to evolve with their jobs and adapt to workplace change. For further information on the OSP and the Essential Skills, visit http://skills.edu.gov.on.ca.

THE ROLE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY IN TECHNOLOGICAL EDUCATION

Information and communications technologies (ICT) provide a range of tools that can significantly extend and enrich teachers' instructional strategies and support student learning. ICT tools include multimedia resources, databases, Internet websites, digital cameras, and word-processing programs. Tools such as these can help students to collect, organize, and sort the data they gather and to write, edit, and present reports on their findings. Information and communications technologies can also be used to connect students to other schools, at home and abroad, and to bring the global community into the local classroom.

Whenever appropriate, therefore, students should be encouraged to use ICT to support and communicate their learning. For example, students working individually or in groups can use computer technology and/or Internet websites to gain access to technical information in Canada and around the world. Students can also use digital cameras and projectors to design and present the results of their research to their classmates.

Although the Internet is a powerful learning tool, there are potential risks attached to its use. All students must be made aware of issues of Internet privacy, safety, and responsible use, as well as of the potential for abuse of this technology, particularly when it is used to bully or promote hatred.

Teachers will find the various ICT tools useful in their teaching practice, both for whole-class instruction and for the design of curriculum units that contain varied approaches to learning to meet diverse student needs.

PLANNING TECHNOLOGICAL EDUCATION PROGRAMS FOR STUDENTS WITH SPECIAL EDUCATION NEEDS

Classroom teachers are the key educators of students who have special education needs. They have a responsibility to help all students learn, and they work collaboratively with special education resource teachers, where appropriate, to achieve this goal.

Special Education Transformation: The Report of the Co-Chairs with the Recommendations of the Working Table on Special Education, 2006 endorses a set of beliefs that should guide program planning for students with special education needs *in all disciplines*. Those beliefs are as follows:

- All students can succeed.
- Universal design[4] and differentiated instruction[5] are effective and interconnected means of meeting the learning or productivity needs of any group of students.
- Successful instructional practices are founded on evidence-based research, tempered by experience.
- Classroom teachers are key educators for a student's literacy and numeracy development.
- Each student has his or her own unique patterns of learning.
- Classroom teachers need the support of the larger community to create a learning environment that supports students with special education needs.
- Fairness is not sameness.

In any given classroom, students may demonstrate a wide range of strengths and needs. Teachers plan programs that recognize this diversity and give students performance tasks that respect their particular abilities so that all students can derive the greatest possible benefit from the teaching and learning process. The use of flexible groupings for instruction and the provision of ongoing assessment are important elements of programs that accommodate a diversity of learning needs.

In planning technological education courses for students with special education needs, teachers should begin by examining the current achievement level of the individual student, the strengths and learning needs of the student, and the knowledge and skills that all students are expected to demonstrate at the end of the course, in order to determine which of the following options is appropriate for the student:

- no accommodations[6] or modified expectations; or
- accommodations only; or
- modified expectations, with the possibility of accommodations; or
- alternative expectations, which are not derived from the curriculum expectations for a course and which constitute alternative programs and/or courses.

If the student requires either accommodations or modified expectations, or both, the relevant information, as described in the following paragraphs, must be recorded in his or her Individual Education Plan (IEP). More detailed information about planning programs for students with special education needs, including students who require alternative programs and/or courses,[7] can be found in *The Individual Education Plan (IEP): A Resource Guide, 2004* (referred to hereafter as the *IEP Resource Guide, 2004*). For a detailed discussion

4. The goal of Universal Design for Learning (UDL) is to create a learning environment that is open and accessible to all students, regardless of age, skills, or situation. Instruction based on principles of universal design is flexible and supportive, can be adjusted to meet different student needs, and enables all students to access the curriculum as fully as possible.

5. Differentiated instruction is effective instruction that shapes each student's learning experience in response to his or her particular learning preferences, interests, and readiness to learn.

6. "Accommodations" refers to individualized teaching and assessment strategies, human supports, and/or individualized equipment.

7. Alternative programs are identified on the IEP form by the term "alternative (ALT)".

of the ministry's requirements for IEPs, see *Individual Education Plans: Standards for Development, Program Planning, and Implementation, 2000* (referred to hereafter as *IEP Standards, 2000*). (Both documents are available at www.edu.gov.on.ca.)

Students Requiring Accommodations Only

Some students are able, with certain accommodations, to participate in the regular course curriculum and to demonstrate learning independently. Accommodations allow access to the course without any changes to the knowledge and skills the student is expected to demonstrate. The accommodations required to facilitate the student's learning must be identified in his or her IEP (see *IEP Standards, 2000*, p. 11). A student's IEP is likely to reflect the same accommodations for many, or all, subjects or courses.

Providing accommodations to students with special education needs should be the first option considered in program planning. Instruction based on principles of universal design and differentiated instruction focuses on the provision of accommodations to meet the diverse needs of learners.

There are three types of accommodations:

- *Instructional accommodations* are changes in teaching strategies, including styles of presentation, methods of organization, or use of technology and multimedia.
- *Environmental accommodations* are changes that the student may require in the classroom and/or school environment, such as preferential seating or special lighting.
- *Assessment accommodations* are changes in assessment procedures that enable the student to demonstrate his or her learning, such as allowing additional time to complete tests or assignments or permitting oral responses to test questions (see page 29 of the *IEP Resource Guide, 2004*, for more examples).

If a student requires "accommodations only" in technological education courses, assessment and evaluation of his or her achievement will be based on the appropriate course curriculum expectations and the achievement levels outlined in this document. The IEP box on the student's Provincial Report Card will not be checked, and no information on the provision of accommodations will be included.

Students Requiring Modified Expectations

Some students will require modified expectations, which differ from the regular course expectations. For most students, modified expectations will be based on the regular course curriculum, with changes in the number and/or complexity of the expectations. Modified expectations represent specific, realistic, observable, and measurable achievements and describe specific knowledge and/or skills that the student can demonstrate independently, given the appropriate assessment accommodations.

It is important to monitor, and to reflect clearly in the student's IEP, the extent to which expectations have been modified. As noted in Section 7.12 of the ministry's policy document *Ontario Secondary Schools, Grades 9 to 12: Program and Diploma Requirements, 1999*, the principal will determine whether achievement of the modified expectations constitutes successful completion of the course, and will decide whether the student is eligible to receive a credit for the course. This decision must be communicated to the parents and the student.

When a student is expected to achieve most of the curriculum expectations for the course, the modified expectations should identify *how the required knowledge and skills differ from those identified in the course expectations*. When modifications are so extensive that achievement of the learning expectations (knowledge, skills, and performance tasks) is not likely to result in a credit, the expectations should *specify the precise requirements or tasks on which the student's performance will be evaluated* and which will be used to generate the course mark recorded on the Provincial Report Card.

Modified expectations indicate the knowledge and/or skills the student is expected to demonstrate and have assessed in each reporting period (*IEP Standards, 2000*, pp. 10 and 11). The student's learning expectations must be reviewed in relation to the student's progress at least once every reporting period, and must be updated as necessary (*IEP Standards, 2000*, p. 11).

If a student requires modified expectations in technological education courses, assessment and evaluation of his or her achievement will be based on the learning expectations identified in the IEP and on the achievement levels outlined in this document. If some of the student's learning expectations for a course are modified but the student is working towards a credit for the course, it is sufficient simply to check the IEP box on the Provincial Report Card. If, however, the student's learning expectations are modified to such an extent that the principal deems that a credit will not be granted for the course, the IEP box must be checked and the appropriate statement from the *Guide to the Provincial Report Card, Grades 9–12, 1999* (p. 8) must be inserted. The teacher's comments should include relevant information on the student's demonstrated learning of the modified expectations, as well as next steps for the student's learning in the course.

PROGRAM CONSIDERATIONS FOR ENGLISH LANGUAGE LEARNERS

Ontario schools have some of the most multilingual student populations in the world. The first language of approximately 20 per cent of the students in Ontario's English language schools is a language other than English. Ontario's linguistic heritage includes several Aboriginal languages and many African, Asian, and European languages. It also includes some varieties of English – also referred to as dialects – that differ significantly from the English required for success in Ontario schools. Many English language learners were born in Canada and have been raised in families and communities in which languages other than English, or varieties of English that differ from the language used in the classroom, are spoken. Other English language learners arrive in Ontario as newcomers from other countries; they may have experience of highly sophisticated educational systems, or they may have come from regions where access to formal schooling was limited.

When they start school in Ontario, many of these students are entering a new linguistic and cultural environment. All teachers share in the responsibility for these students' English language development.

English language learners (students who are learning English as a second or additional language in English language schools) bring a rich diversity of background knowledge and experience to the classroom. These students' linguistic and cultural backgrounds not only support their learning in their new environment but also become a cultural asset in the classroom community. Teachers will find positive ways to incorporate this diversity into their instructional programs and into the classroom environment.

Most English language learners in Ontario schools have an age-appropriate proficiency in their first language. Although they need frequent opportunities to use English at school, there are important educational and social benefits associated with continued development of their first language while they are learning English. Teachers need to encourage parents to continue to use their own language at home in rich and varied ways as a foundation for language and literacy development in English. It is also important for teachers to find opportunities to bring students' languages into the classroom, using parents and community members as a resource.

During their first few years in Ontario schools, English language learners may receive support through one of two distinct programs from teachers who specialize in meeting their language-learning needs:

English as a Second Language (ESL) programs are for students born in Canada or newcomers whose first language is a language other than English, or is a variety of English significantly different from that used for instruction in Ontario schools.

English Literacy Development (ELD) programs are primarily for newcomers whose first language is a language other than English, or is a variety of English significantly different from that used for instruction in Ontario schools, and who arrive with significant gaps in their education. These students generally come from countries where access to education is limited or where there are limited opportunities to develop language and literacy skills in any language. Some Aboriginal students from remote communities in Ontario may also have had limited opportunities for formal schooling, and they also may benefit from ELD instruction.

In planning programs for students with linguistic backgrounds other than English, teachers need to recognize the importance of the orientation process, understanding that every learner needs to adjust to the new social environment and language in a unique way and at an individual pace. For example, students who are in an early stage of English-language acquisition may go through a "silent period" during which they closely observe the interactions and physical surroundings of their new learning environment. They may use body language rather than speech or they may use their first language until they have gained enough proficiency in English to feel confident of their interpretations and responses. Students thrive in a safe, supportive, and welcoming environment that nurtures their self-confidence while they are receiving focused literacy instruction. When they are ready to participate, in paired, small-group, or whole-class activities, some students will begin by using a single word or phrase to communicate a thought, while others will speak quite fluently.

With exposure to the English language in a supportive learning environment, most young children will develop oral fluency quite quickly, making connections between concepts and skills acquired in their first language and similar concepts and skills presented in English. However, oral fluency is not a good indicator of a student's knowledge of vocabulary or sentence structure, reading comprehension, or other aspects of language proficiency that play an important role in literacy development and academic success. Research has shown that it takes five to seven years for most English language learners to catch up to their English-speaking peers in their ability to use English for academic purposes. Moreover, the older the children are when they arrive, the greater the amount of language knowledge and skills that they have to catch up on, and the more direct support they require from their teachers.

Responsibility for students' English-language development is shared by the classroom teacher, the ESL/ELD teacher (where available), and other school staff. Volunteers and peers may also be helpful in supporting English language learners in the language classroom. Teachers must adapt the instructional program in order to facilitate the success of these students in their classrooms. Appropriate adaptations include:

- modification of some or all of the subject expectations so that they are challenging but attainable for the learner at his or her present level of English proficiency, given the necessary support from the teacher;
- use of a variety of instructional strategies (e.g., extensive use of visual cues, graphic organizers, and scaffolding; previewing of textbooks; pre-teaching of key vocabulary; peer tutoring; strategic use of students' first languages);
- use of a variety of learning resources (e.g., visual material, simplified text, bilingual dictionaries, and materials that reflect cultural diversity);
- use of assessment accommodations (e.g., granting of extra time; use of oral interviews, demonstrations or visual representations, or tasks requiring completion of graphic organizers or cloze sentences instead of essay questions and other assessment tasks that depend heavily on proficiency in English).

When learning expectations in any course are modified for an English language learner (whether the student is enrolled in an ESL or ELD course or not), this information must be clearly indicated on the student's report card.

Although the degree of program adaptation required will decrease over time, students who are no longer receiving ESL or ELD support may still need some program adaptations to be successful.

For further information on supporting English language learners, refer to *The Ontario Curriculum, Grades 9–12: English as a Second Language and English Literacy Development, 2007; English Language Learners – ESL and ELD Programs and Services: Policies and Procedures for Ontario Elementary and Secondary Schools, Kindergarten to Grade 12, 2007;* and the resource guides *Supporting English Language Learners with Limited Prior Schooling: A Practical Guide for Ontario Educators, Grades 3 to 12, 2008* and *Many Roots, Many Voices: Supporting English Language Learners in Every Classroom, 2005.*

ANTIDISCRIMINATION EDUCATION IN TECHNOLOGICAL EDUCATION

The implementation of antidiscrimination principles in education influences all aspects of school life. It promotes a school climate that encourages all students to work to attain high standards, affirms the worth of all students, and helps students strengthen their sense of identity and develop a positive self-image. It encourages staff and students alike to value and show respect for diversity in the school and the wider society. It requires schools to adopt measures to provide a safe environment for learning, free from harassment, violence, and expressions of hate.

Antidiscrimination education encourages students to think critically about themselves and others in the world around them in order to promote fairness, healthy relationships, and active, responsible citizenship.

Schools have the responsibility to ensure that school–community interaction reflects the diversity in the local community and wider society. Consideration should be given to a variety of strategies for communicating and working with parents and community members from diverse groups, in order to ensure their participation in such school activities as technology fairs, plays, and teacher interviews. Families new to Canada, who may be unfamiliar with the Ontario school system, or parents of Aboriginal students may need special outreach and encouragement in order to feel comfortable in their interactions with the school.

When planning instructional activities for technological education, teachers should base their decisions on the needs of students, taking into consideration the diversity of their abilities, backgrounds, interests, and learning styles. Teaching strategies, assessment and evaluation materials, and the classroom environment should be designed to value the experiences and contributions of all people.

Participation rates in some technological education subjects tend to be higher for male students than female students. To encourage greater participation among female students, it may be helpful to offer more projects and activities that have socially meaningful applications. For example, projects to develop assistive devices, as opposed to the more traditional activity of creating robotic arms, have proved successful in engaging the interest of female students. Similarly, projects involving the construction of playground equipment as opposed to the more traditional sheds and building structures may hold more appeal for young women. Providing outreach programs and establishing study groups for young women may help them develop greater self-confidence in technological education. Technology fairs and showcase events can introduce all students to a wide range of technology activities, and may encourage an interest in technological education. Offering choices from a range of instructional activities or allowing students to select their own projects can help motivate all the students in a classroom by acknowledging the differences in their experiences, attitudes, and interests.

It is important to have open and frank discussions about the kind of workplace environment students are likely to encounter in technological fields. Inviting female and visible minority role models who have had successful careers in various technology sectors to be guest speakers, and involving female and visible minority senior students as mentors, can have a very positive impact on students. Also, exploring strategies that would enable those with different learning and social styles, including Aboriginal students and students from other minority groups, to work effectively together will help establish a more inclusive working environment.

ENVIRONMENTAL EDUCATION IN TECHNOLOGICAL EDUCATION

> *Environmental education is education about the environment, for the environment, and in the environment that promotes an understanding of, rich and active experience in, and an appreciation for the dynamic interactions of:*
>
> - *the Earth's physical and biological systems*
> - *the dependency of our social and economic systems on these natural systems*
> - *the scientific and human dimensions of environmental issues*
> - *the positive and negative consequences, both intended and unintended, of the interactions between human-created and natural systems.*
>
> *Shaping Our Schools, Shaping Our Future: Environmental Education in Ontario Schools (June 2007)*, p. 6

As noted in *Shaping Our Schools, Shaping Our Future*, environmental education "is the responsibility of the entire education community. It is a content area and can be taught. It is an approach to critical thinking, citizenship, and personal responsibility, and can be modelled. It is a context that can enrich and enliven education in all subject areas and offer students the opportunity to develop a deeper connection with themselves, their role in society, and their interdependence on one another and the Earth's natural systems" (p. 10).

There are many opportunities to integrate environmental education into the teaching of technological education. In each of the technological education courses, the expectations in the Technology/Industry Practices, the Environment, and Society strand allow students to develop critical thinking skills and an understanding of responsible practice with respect to the environmental implications of the technology they are studying. Students analyse the impact of technology on the environment and learn about the safe handling and disposal of materials and substances used in the development of products and the provision of services. In this way, students are able to explore how simple human interactions with the environment can have significant consequences. Students will be expected to actively engage in developing and implementing strategies to reduce, reuse, and recycle materials and products, and will learn about government agencies and community partners that have developed relevant opportunities to support such practices. By identifying and implementing measures to reduce the negative effects of technology on the environment, students will be contributing to responsible environmental stewardship.

The dynamic relationships resulting from human interaction with the environment provide a rich context for developing authentic learning activities in technological education courses. Technological education projects can readily be designed to integrate content and principles relevant to environmental education. For example, students can be engaged in constructing solar-powered devices, designing recycling centres, or creating media projects that focus on environmental awareness.

LITERACY, MATHEMATICAL LITERACY, AND INQUIRY/RESEARCH SKILLS

Literacy, mathematical literacy, and inquiry/research skills are critical to students' success in all subjects of the curriculum and in all areas of their lives.

Many of the activities and tasks that students undertake in the technological education curriculum involve the literacy skills relating to oral, written, and visual communication. For example, students use language to describe their plans and the progress of their designs and projects in both informal and formal contexts, to produce work orders, and to report on the results of their projects in presentations and technical and other reports in oral, written, graphic, and multimedia forms. Technological education also requires the use and understanding of specialized terminology. In all technological education courses, students are required to use appropriate and correct terminology, and are encouraged to use language with care and precision in order to communicate effectively.

The technological education program also builds on, reinforces, and enhances mathematical literacy. For example, clear, concise communication often involves the use of diagrams, tables, and graphs, and many components of the technological education curriculum emphasize students' ability to interpret and use symbols and charts. Students are also required to take accurate measurements, produce plans to specified dimensions, and use metric and imperial systems of measurement, as required in their particular area of study.

Inquiry and research are at the heart of learning in all subject areas. In technological education courses, students are encouraged to develop their ability to analyse the context and background of challenges and to explore a variety of possible solutions to those challenges. As students advance through the grades, they acquire the skills to locate information relevant to solving problems and addressing challenges from a variety of sources, such as books, magazines, manuals, technical reports, dictionaries, client interviews, videos, and the Internet. As students in technological education courses conduct such research, teachers should guide them in recognizing that all sources of information have a particular point of view and that the recipient of the information has a responsibility to evaluate that information, determine its validity and relevance, and use it in appropriate ways. The ability to locate, question, and evaluate information allows a student to become an independent, lifelong learner.

CAREER EDUCATION

Ongoing discoveries and innovations coupled with rapidly evolving technologies have resulted in an exciting environment in which creativity and innovation thrive, bringing about new career opportunities. Today's employers seek candidates with strong technical skills, critical-thinking and problem-solving skills, and the ability to work cooperatively in a team, traits that are developed through participation in technological education. Technological education courses enable students to develop problem-solving skills, design skills, technical knowledge and skills, and the ability to conduct research, present results, and work on projects both independently and in a team environment.

COOPERATIVE EDUCATION AND OTHER FORMS OF EXPERIENTIAL LEARNING

Cooperative education and other forms of experiential learning, such as job shadowing, field trips, and work experience, are central to technological education, enabling students to apply the skills they have developed in the classroom to real-life activities in the community and in the world of technological innovation. Cooperative education and other workplace experiences also help to broaden students' knowledge of employment opportunities in a wide range of fields, including industrial, motive power, construction, service, and agricultural trades; engineering; hospitality and tourism; and health care. In addition, students develop their understanding of workplace practices, certifications, and the nature of employer–employee relationships. Teachers of technological education can support their students' learning by maintaining links with community-based businesses to ensure that students have access to hands-on experiences that will reinforce the knowledge and skills gained in school.

Students who choose a technological education course as the related course for two cooperative education credits are able, through this packaged program, to meet the group 1, 2, and 3 compulsory credit requirements for the OSSD.

Health and safety issues must be addressed when learning involves cooperative education and other workplace experiences. Teachers who provide support for students in workplace learning placements need to assess placements for safety and ensure that students understand the importance of issues relating to health and safety in the workplace. Before taking part in workplace learning experiences, students must acquire the knowledge and skills needed for safe participation. Students must understand their rights to privacy and confidentiality as outlined in the Freedom of Information and Protection of Privacy Act. They have the right to function in an environment free from abuse and harassment, and they need to be aware of harassment and abuse issues in establishing boundaries for their own personal safety. They should be informed about school and community resources and school policies and reporting procedures with respect to all forms of abuse and harassment.

Policy/Program Memorandum No. 76A, "Workplace Safety and Insurance Coverage for Students in Work Education Programs" (September 2000), outlines procedures for ensuring the provision of Health and Safety Insurance Board coverage for students who are at least 14 years of age and are on placements of more than one day. (A one-day job-shadowing or job-twinning experience is treated as a field trip.) Teachers should also be aware of the minimum age requirements outlined in the Occupational Health and Safety Act for persons to be in or to be working in specific workplace settings. All cooperative education and other workplace experiences will be provided in accordance with the ministry's policy document *Cooperative Education and Other Forms of Experiential Learning: Policies and Procedures for Ontario Secondary Schools, 2000.*

PLANNING PROGRAM PATHWAYS AND PROGRAMS LEADING TO A SPECIALIST HIGH SKILLS MAJOR

Technological education courses are well suited for inclusion in some programs leading to a Specialist High Skills Major (SHSM) or in programs designed to provide pathways to particular apprenticeship or workplace destinations. In some SHSM programs, technological education courses can be bundled with other courses to provide the academic knowledge and skills important to particular industry sectors and required for success in the workplace and postsecondary education, including apprenticeship. Technological education courses may also be combined with cooperative education credits to provide the workplace experience required for some SHSM programs and for various program pathways to apprenticeship and workplace destinations. SHSM programs would also include sector-specific learning opportunities offered by employers, skills-training centres, colleges, and community organizations.

COURSES

Exploring Technologies, Grade 9

Open — TIJ1O

This course enables students to further explore and develop technological knowledge and skills introduced in the elementary science and technology program. Students will be given the opportunity to design and create products and/or provide services related to the various technological areas or industries, working with a variety of tools, equipment, and software commonly used in industry. Students will develop an awareness of environmental and societal issues, and will begin to explore secondary and postsecondary education and training pathways leading to careers in technology-related fields.

Prerequisite: None

Note: *Schools may offer broad-based courses, using the expectations provided here for Exploring Technologies, that focus on a particular subject area within the technological education curriculum. Brief descriptions for courses in each of the subject areas are given below, along with the course codes assigned to them. For more information about the delivery of such courses, see pages 10–13.*

Exploring Communications Technology (TGJ1O)

This exploratory course introduces students to concepts and skills in communications technology, which encompasses television/video and movie production, radio and audio production, print and graphic communications, photography, and interactive new media and animation. Students will develop an awareness of related environmental and societal issues, and will begin to explore secondary and postsecondary pathways leading to careers in the field.

Exploring Computer Technology (TEJ1O)

This exploratory course introduces students to concepts and skills in computer technology, which encompasses computer systems, networking, interfacing, and programming, as well as electronics and robotics. Students will develop an awareness of related environmental and societal issues, and will begin to explore secondary and postsecondary pathways leading to careers in the field.

Exploring Construction Technology (TCJ1O)

This exploratory course introduces students to concepts and skills in construction technology, which encompasses plumbing, electrical and network wiring, masonry, heating/cooling, carpentry, and woodworking. Students will develop an awareness of related environmental and societal issues, and will begin to explore secondary and postsecondary pathways leading to careers in the field.

Exploring Green Industries (THJ1O)

This exploratory course introduces students to concepts and skills related to the green industries – agriculture, forestry, horticulture, floristry, and landscaping. Students will develop an awareness of related environmental and societal issues, and will begin to explore secondary and postsecondary pathways leading to careers in the field.

Exploring Hairstyling and Aesthetics (TXJ1O)

This exploratory course introduces students to concepts and skills related to hairstyling and aesthetics, including hair, nail, and skin care applications. Students will develop an awareness of related environmental and societal issues, and will begin to explore secondary and postsecondary pathways leading to careers in the field.

Exploring Health Care (TPJ1O)

This exploratory course introduces students to concepts and skills related to health care, which encompasses personal health promotion, child and adolescent health concerns, and various medical services, treatments, instruments, and technologies. Students will develop an awareness of related environmental and societal issues, and will begin to explore secondary and postsecondary pathways leading to careers in the field.

Exploring Hospitality and Tourism (TFJ1O)

This exploratory course introduces students to concepts and skills related to hospitality and tourism, focusing on the areas of food handling, food preparation, the origins of foods, event planning, and local tourism. Students will develop an awareness of related environmental and societal issues, and will begin to explore secondary and postsecondary pathways leading to careers in the field.

Exploring Manufacturing Technology (TMJ1O)

This exploratory course introduces students to concepts and skills related to manufacturing technology, which encompasses technical drawing, properties and preparation of materials, manufacturing techniques, and control systems. Students will develop an awareness of related environmental and societal issues, and will begin to explore secondary and postsecondary pathways leading to careers in the field.

Exploring Technological Design (TDJ1O)

This exploratory course introduces students to concepts and skills related to technological design, which involves the development of solutions to various design challenges and the fabrication of models or prototypes of those solutions. Students will develop an awareness of related environmental and societal issues, and will begin to explore secondary and postsecondary pathways leading to careers in the field.

Exploring Transportation Technology (TTJ1O)

This exploratory course introduces students to concepts and skills related to transportation technology, which encompasses the maintenance, servicing, and repair of various types of vehicles, aircraft, and/or watercraft. Students will develop an awareness of related environmental and societal issues, and will begin to explore secondary and postsecondary pathways leading to careers in the field.

A. TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of the fundamental concepts and skills required in the planning and development of a product or service, including the use of a design process and/or other problem-solving processes and techniques;

A2. demonstrate the ability to use a variety of appropriate methods to communicate ideas and solutions;

A3. evaluate products or services in relation to specifications, user requirements, and operating conditions.

SPECIFIC EXPECTATIONS

A1. Planning and Development

By the end of this course, students will:

A1.1 describe a design process or other problem-solving process for planning and developing products and/or services (see pp. 16–19);[1]

A1.2 describe problem-solving processes and techniques for solving various kinds of problems in different technological areas;

A1.3 apply correctly the mathematical and scientific concepts and skills required in the planning and development of a product and/or service;

A1.4 incorporate appropriate technological concepts *(e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication/building/creation, function, innovation, material, mechanism, power and energy, safety, structure, systems)* in the design, fabrication or delivery, and evaluation of a product or service (see pp. 5–6);

A1.5 describe the characteristics of a variety of materials used in the fabrication of a product or the delivery of a service *(e.g., strength, durability, possible toxicity, lifespan, density, nutritional value, flavour, asepsis)* and identify other relevant considerations to be made in relation to those materials *(e.g., cost, availability)*;

A1.6 demonstrate an understanding of the roles of various team members in a group project *(e.g., leader, recorder, timekeeper)*;

A1.7 research and describe the development of a Canadian technological innovation or invention *(e.g., snowmobile, personal communication device, potato digger, odometer, anti-gravity suit, CPR mannequin, zipper)*.

A2. Communication

By the end of this course, students will:

A2.1 use a variety of appropriate methods to communicate information or ideas and concepts during the planning and production stages of a project *(e.g., production plans, scripts, flow charts, storyboards, sketches, technical drawings, recipes, client consultation reports, design briefs)*;

A2.2 use correct terminology to identify and describe various processes, tools, and equipment used in creating products or delivering services *(e.g., **processes:** levelling, squaring, formulating, baking, sterilizing, colouring; **tools:** pruning saw, wire cutter, curling iron; **equipment:** USB flash drive, tire balancer, camcorder, flat iron, deep fryer, magnifying lamp, ultraviolet sanitizer, solderless breadboard, measuring cup, thermometer)*;

1. The products and services referred to throughout this course should be drawn from various areas of technological education, which include communications technology, computer technology, construction technology, green industries, hairstyling and aesthetics, health care, hospitality and tourism, manufacturing technology, technological design, and transportation technology. Examples of products might include an electronic communication device, a jewellery box, an individual meal plan or a restaurant menu, a traffic light model and simulator, a Rube Goldberg machine, a piece of animation, a website, a photography exhibit, a wheelchair ramp, a locker organizer, theatre props, a garden, a floral arrangement, and a plant stand. Examples of services might include staging a fashion show, providing health care services, operating a food bank, and planning and producing holiday events or a school production.

A2.3 use metric and imperial units of measurement *(e.g., **metric:** degrees Celsius, joules, micrometres [microns], millimetres, kilohms, L/100 km, tonnes; **imperial:** degrees Fahrenheit, BTUs, knots, mils, inches, feet, miles per gallon, pounds per square inch, tons)* and the abbreviations or symbols associated with them correctly and as appropriate to the task;

A2.4 describe and use various forms of communication to document the progress and results of the development of a product or service *(e.g., tracking sheets, production status reports, a multimedia presentation, a graphic or animated presentation, technical drawings, updates on a website, a blog, technical reports)*;

A2.5 describe some common applications of information and communications technology in various technological areas *(e.g., automotive on-board diagnostics, computers, non-linear video editing, broadband networks, weather reports, online reservation systems, electronic medical alert systems)*.

A3. Product or Service Evaluation

By the end of this course, students will:

A3.1 evaluate a product or service, and processes associated with its development, on the basis of a set of criteria relevant to that product or service *(e.g., adherence to specifications, ease of use, attractive appearance, ruggedness, clean joints, acceptable weld bead, uniform colour, adherence to forest management plan, nutritional value)*;

A3.2 suggest improvements to a product or service on the basis of a set of criteria relevant to that product or service *(e.g., durability, reliability, ease of use, eco-friendliness, appearance, safety, customer satisfaction)*.

B. TECHNOLOGICAL SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. use problem-solving processes and project-management strategies in the planning and fabrication of a product or delivery of a service;

B2. fabricate products or deliver services, using a variety of resources.

SPECIFIC EXPECTATIONS

B1. Problem Solving and Project Management

By the end of this course, students will:

B1.1 apply the steps of a design process or other problem-solving process to plan and develop products and services *(e.g., define the problem or challenge, taking into account relevant contextual or background information; gather information [about criteria, materials, constraints]; generate possible solutions, using techniques such as brainstorming; choose the best solution; develop and produce a model or prototype; test the model or prototype; incorporate improvements or redesign and retest; report on results)* (see pp. 16–19);

B1.2 apply the steps and/or techniques of appropriate problem-solving processes and methods *(e.g., diagnostics, reverse engineering, trial and error, divide and conquer, parts substitution, extreme cases)* to solve a variety of problems in different technological areas (see pp. 16–19);

B1.3 identify and discuss solutions that have been developed to address key technological problems or meet human needs in various areas of technology *(e.g., catalytic converters, CPU heat sinks, solar cells, regenerative brake energy systems, wind turbines, convection ovens, internal defibrillators, scent-free and hypoallergenic products)*;

B1.4 use a variety of sources to research technological solutions to specific problems or challenges *(e.g., the Internet, reference books, journals or magazines, experts)*;

B1.5 demonstrate the ability to work cooperatively in a group environment to solve problems *(e.g., share tools, tasks, materials, and resources)*;

B1.6 use appropriate communication, time-management, and organizational strategies *(e.g., active listening, scheduling, flow charts, meal plans)* to facilitate the process of developing a product or service.

B2. Creating Products or Delivering Services

By the end of this course, students will:

B2.1 use appropriate tools, materials, and equipment *(e.g., **tools:** hammer, chisel, screwdrivers, soldering iron, cheese grater, sieve, seam ripper; pruning shears, hair clipper; **materials:** wood, aluminum, polystyrene, paper, wax, clay, textiles, electronic components, mulch, hair colour; **equipment:** drill press, test meter, computer, software, printer, video camera, thermometer, grill, sewing machine, autoclave, curling iron)* to create products or deliver services;

B2.2 make accurate measurements using a variety of tools *(e.g., ruler, scale, tape measure, caliper, micrometer, thermometer, measuring cup)*, in metric or imperial units, as appropriate;

B2.3 meet all design criteria *(e.g., technical requirements, type and quality of materials, appearance, ease of use, safety, timeline, client's expectations)* in creating a product or delivering a service;

B2.4 demonstrate the ability to use, maintain, and store tools and equipment properly and with care.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an awareness of the effects of various technologies on the environment;

C2. demonstrate an awareness of how various technologies affect society, as well as how society influences technological developments.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 describe how various technologies *(e.g., integrated pest management, water purification, mass transit, agricultural technologies, resource extraction)* affect the environment, and identify important environmental considerations associated with different areas of technology *(e.g., how to deal with ozone-depleting chemicals or hazardous wastes; how to increase opportunities for recycling, conservation, use of sustainable methods or materials)*;

C1.2 identify technological solutions that have been designed in response to environmental concerns *(e.g., catalytic converter, wind turbines, solar-powered signs, biofuels, non-toxic and hypoallergenic products, recyclable and reusable packaging)*;

C1.3 follow proper procedures for the safe storage and disposal of materials and waste products *(e.g., keep flammable solvents, paints, and varnishes in non-combustible cabinets; recycle used motor oil)*.

C2. Technology and Society

By the end of this course, students will:

C2.1 describe some of the effects that technological innovations of the past have had on society *(e.g., effects on health, on people's ability to travel and communicate, on living standards, on education)* and the economy *(e.g., creation of new types of jobs, automation of factories)*;

C2.2 describe how society is being affected today by various new and emerging technologies *(e.g., electronic messaging, Global Positioning System [GPS], wireless access, hybrid vehicles, nanotechnology, biotechnology)*;

C2.3 describe economic, ecological, social, and safety considerations facing consumers when they make choices between particular products or services *(e.g., natural versus synthetic materials, renewable versus non-renewable resources; inexpensive products created in developing countries versus more costly products created domestically; higher-priced products with additional safety features versus less costly products without them)*;

C2.4 demonstrate an understanding of, and respect for, cultural and social diversity as they develop and create various products or services *(e.g., prepare foods from various countries around the world, use video or graphic images that are representative of the school population, demonstrate hairstyles from various cultures, compare traditional landscaping styles of different cultures)*;

C2.5 describe how social and economic factors influence the development and use of technology *(e.g., high fuel prices and safety concerns influence automotive design, rotating blackouts speed the development of energy alternatives, people's desire to be connected with family and friends drives telephone and wireless device design)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. follow safe practices and procedures when using materials, tools, and equipment;

D2. identify careers in various technological fields, and describe the educational requirements for them.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 use appropriate personal protective equipment *(e.g., gloves, safety glasses or goggles, hard-hat, hearing protection, respirator mask)*;

D1.2 use the safety features of tools and equipment *(e.g., bandsaw guard, stock guides, tire balancer cover)* appropriately;

D1.3 follow proper shop practices, which help protect the safety of workers *(e.g., keep work area clean and organized, avoid horseplay)*;

D1.4 use appropriate aids *(e.g., push stick, feather-board, soldering iron holder)* to minimize the risk of injury;

D1.5 use appropriate strategies to prevent health problems (*e.g., follow proper sanitation and sterilization practices; ensure proper ventilation; use proper lifting techniques; follow Workplace Hazardous Materials Information System [WHMIS] and Material Safety Data Sheet [MSDS] guidelines)*.

D2. Career Opportunities

By the end of this course, students will:

D2.1 describe secondary and postsecondary education pathways (i.e., selection of courses, programs, experiential learning opportunities, and other learning opportunities at the secondary and postsecondary levels, including apprenticeship training, certificate programs, college programs, and/or university programs) leading to a variety of careers in technological fields;

D2.2 use various criteria to assess selected careers in technological fields *(e.g., salary, job demand, working conditions, social trends)*;

D2.3 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in a technology industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D2.4 demonstrate an understanding of the Essential Skills that are important for success in the technology industries, as identified in the Ontario Skills Passport *(e.g., reading text, writing, document use, computer use, oral communication, numeracy, thinking skills)*;

D2.5 demonstrate an understanding of the work habits that are important for success in the technology industries, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability, organization, working independently, initiative, self-advocacy, customer service)*;

D2.6 develop and/or select pieces of work and other materials that provide evidence of their skills and achievements in technology, for inclusion in a portfolio *(e.g., Passport to Safety certificate, project photographs, sketches, drawings, skills checklist, work logs)*.

Communications Technology, Grade 10

Open — TGJ2O

This course introduces students to communications technology from a media perspective. Students will work in the areas of TV/video and movie production, radio and audio production, print and graphic communications, photography, and interactive new media and animation. Student projects may include computer-based activities such as creating videos, editing photos, working with audio, cartooning, developing animations, and designing web pages. Students will also develop an awareness of environmental and societal issues related to communications technology, and will explore secondary and post-secondary education and training pathways and career opportunities in the various communications technology fields.

Prerequisite: None

A. COMMUNICATIONS TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of the core concepts, techniques, and skills required to produce a range of communications media products or services;

A2. demonstrate an understanding of technical terminology, basic scientific concepts, and mathematical concepts used in communications technology and apply them to the creation of media products;

A3. demonstrate an understanding of and apply the interpersonal and communication skills necessary to work effectively in a team setting.

SPECIFIC EXPECTATIONS

A1. Core Concepts, Techniques, and Skills

By the end of this course, students will:

A1.1 describe the elements of the universal communications model *(e.g., message, sender, mode of transmission, receiver)*;

A1.2 demonstrate an understanding of design elements *(e.g., line, form, colour, texture, space)* and principles *(e.g., balance, rhythm, proportion, contrast, flow)*;

A1.3 demonstrate an understanding of production processes and workflows *(e.g., subject/location selection, lighting set-up, shooting, digital imaging, and digital editing in audio/video and photography; layout, pre-press, presswork, and binding in publishing; site design, page layout, content development, and testing in web design)*;

A1.4 identify different types of communications technology devices and their components *(e.g., cameras and accessories, lighting equipment, audio and video recorders, audio mixers, scanners, printing equipment)*, and explain how they are used to produce communications products and services;

A1.5 identify different types of communications software used to create communications technology products and services *(e.g., software for photo, audio, and video editing, animation, page layout, web page creation, and computer graphics)* and describe how they are used.

A2. Technical Terminology and Scientific and Mathematical Concepts

By the end of this course, students will:

A2.1 demonstrate an understanding of communications technology terms, and use them correctly in oral and written communication *(e.g., composition, contrast, scene, typography, layout, storyboard, clip, fade, dissolve, levels, layers, SFX, filters, timeline, site map, navigation)*;

A2.2 demonstrate an understanding of basic scientific concepts that relate to processes and technologies used in communications technology *(e.g., optical principles related to use of cameras and lighting, electronic concepts related to sound recording, principles of digitization and their application to digital imaging and recording)*;

A2.3 apply mathematical concepts and formulas as required to complete communications technology tasks *(e.g., calculation of lighting ratios and exposures in photography and videography, timing of sequences in audio and video editing, calculation of paper and ink requirements in printing, determination of image resolution requirements for printing versus Internet use, calculation of file size)*.

A3. Teamwork

By the end of this course, students will:

A3.1 explain the value of sharing ideas, information, resources, and expertise when working in a team setting;

A3.2 describe and use techniques that encourage participation by all members of a team *(e.g., brainstorming, group discussion, celebration of others' thoughts or contributions, acceptance of cultural differences)*;

A3.3 describe and use concepts and techniques that facilitate effective collaboration in a team environment *(e.g., cooperative discussion, conflict resolution techniques, motivation techniques, respect for the ideas of others)*.

B. COMMUNICATIONS TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. apply project management techniques to the planning and development of communications media products;

B2. apply a design process or other problem-solving processes to meet a range of challenges in communications technology;

B3. create products or productions that demonstrate competence in the application of creative and technical skills.

SPECIFIC EXPECTATIONS

B1. Project Management

By the end of this course, students will:

B1.1 use a variety of planning techniques and tools *(e.g., research, project proposals, production schedules, scripts, blocking, storyboards, site maps, design briefs)* when creating plans for communications technology projects;

B1.2 use appropriate organizational and time-management tools and software applications *(e.g., student planners, journals, electronic organizers, organizing software)* to ensure that project deadlines are met.

B2. Problem Solving

By the end of this course, students will:

B2.1 define a problem or challenge precisely and in adequate detail, taking into account relevant contextual or background information;

B2.2 define project objectives and performance criteria precisely and in adequate detail, and identify constraints such as cost, time, or technology restrictions that will limit design or problem-solving options;

B2.3 use a variety of information sources and research techniques *(e.g., Internet and library searches, checking manuals and other printed materials, consulting experts)* to help identify possible solutions;

B2.4 use idea-generating techniques such as brainstorming or clarification techniques such as situation analyses to help identify possible solutions;

B2.5 use charts or hand-drawn sketches to organize sequences, clarify relationships, or compare alternatives;

B2.6 evaluate possible solutions to identify those that most effectively meet the objectives and criteria within the existing constraints.

B3. Process and Production Skills

By the end of this course, students will:

B3.1 apply creative skills, equipment operating skills, and software skills to create components for a media production *(e.g., text, video footage, voice-overs, graphics, animations for a video promoting a school event)*;

B3.2 apply editing skills to integrate the components into a unified and effective production.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. describe the impact of communications media technologies and activities on the environment and identify ways of reducing their harmful effects;

C2. demonstrate an understanding of social effects and issues arising from the use of communications media technologies and the importance of representing cultural and social diversity in media productions.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 describe the effects of current communications technologies on the environment *(e.g., effects related to paper consumption, energy use, light and sound pollution, disposal of obsolete equipment)*;

C1.2 identify sustainable practices that are currently used or can be used to minimize the impact of communications technologies on the environment *(e.g., recycling of paper, recycling or reuse of electronic components, use of energy-efficient equipment, use of sleep mode when computers are temporarily unused)*.

C2. Technology and Society

By the end of this course, students will:

C2.1 demonstrate an understanding of social standards and cultural sensitivity and use appropriate and inclusive content, images, and language in communications media productions *(e.g., including people from different races, cultures, and backgrounds in media productions; portraying minority groups with respect and sensitivity; avoiding sexism, homophobia, and cultural or racial bias)*;

C2.2 describe the effects of recent changes in communications technology and applications on society and the economy *(e.g., effects arising from the use of devices such as cellular phones, personal digital assistants [PDAs], and portable media players and from the emergence of computer-based social networks, user-generated web content such as wikis and blogs, and easy-to-download music file formats)*;

C2.3 identify emerging communications technologies and describe their potential impact on society and the economy;

C2.4 describe legal concepts and issues relating to communications technology and media production *(e.g., copyright, privacy rights, consent)*;

C2.5 describe social and ethical issues relating to the use of communications technology *(e.g., promotion of hatred, irresponsible use of the Internet, cyberbullying, cultural appropriation)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and apply safe work practices in communications technology activities;

D2. identify career opportunities in communications technology and demonstrate an understanding of the skills, work habits, education, and training required for entry into postsecondary programs or employment in these fields.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 describe industry hazards *(e.g., ergonomic hazards, mechanical hazards, temperature hazards, electrical hazards)* and accident prevention methods *(e.g., health and safety audits)*, and identify sources of accident prevention information *(e.g., the Workplace Hazardous Materials Information System [WHMIS], Passport to Safety)*;

D1.2 apply safe work practices when performing communications technology tasks *(e.g., use ergonomically designed equipment, keep work area tidy, avoid eye strain, use moderate volume levels)*.

D2. Career Opportunities

By the end of this course, students will:

D2.1 identify career opportunities in communications technology and describe the qualifications needed for entry into these positions *(e.g., apprenticeship training, college diploma, university degree, workplace experience)*;

D2.2 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the communications technology industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D2.3 demonstrate an understanding of the Essential Skills that are important for success in the communications technology industry, as identified in the Ontario Skills Passport *(e.g., reading text, writing, document use, computer use, oral communication, numeracy, thinking skills)*;

D2.4 demonstrate an understanding of the work habits that are important for success in the communications technology industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability, initiative, customer service, entrepreneurship)*;

D2.5 develop and/or select pieces of work and other materials that provide evidence of their skills and achievements in communications technology, for inclusion in a portfolio *(e.g., Passport to Safety certificate, skills checklist, photographs, digital media projects)*.

Computer Technology, Grade 10

Open — TEJ2O

This course introduces students to computer systems, networking, and interfacing, as well as electronics and robotics. Students will assemble, repair, and configure computers with various types of operating systems and application software. Students will build small electronic circuits and write computer programs to control simple peripheral devices or robots. Students will also develop an awareness of related environmental and societal issues, and will learn about secondary and postsecondary pathways and career opportunities in computer technology.

Prerequisite: None

A. COMPUTER TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. identify and describe the functions of, as well as important advances related to, electronic and computer components;

A2. demonstrate a basic understanding of computer networks and their components;

A3. demonstrate a basic understanding of binary numbers and digital logic.

SPECIFIC EXPECTATIONS

A1. Computer Hardware

By the end of this course, students will:

A1.1 identify basic electronic components and describe their functions *(e.g., resistors limit current; capacitors store charge, pass high frequencies, and block DC; diodes restrict current in one direction; LEDs indicate current flow; transistors act as amplifiers or switches)*;

A1.2 use precise terminology to identify various types and features of computer hardware and interfaces *(e.g., device name, capacity, speed, bandwidth, connector types)*;

A1.3 identify the basic components and peripheral devices of a computer system *(e.g., mainboard, CPU, power supply, hard drive, monitor, mouse, sound card, printer, scanner)*, and describe their functions;

A1.4 describe important advances in electronic components *(e.g., development of semiconductor technology)* and computer components *(e.g., clock rates, fabrication techniques, bus types)*.

A2. Networking Concepts

By the end of this course, students will:

A2.1 compare various types of networks *(e.g., local area network [LAN] versus wide area network [WAN], peer-to-peer versus client-server)*;

A2.2 describe the basic components of a network *(e.g., workstations, server, network interface cards, routers, switches, hubs)*;

A2.3 compare the various types of data transmission media for networks *(e.g., fibre-optic cable, copper cable, wireless)*;

A2.4 describe how individual workstations are identified on a network *(e.g., logical and physical addressing, verification utilities)*.

A3. Data Representation and Digital Logic

By the end of this course, students will:

A3.1 describe binary numbers, and convert positive integers between binary and decimal number systems *(e.g., convert 247_{10} to binary, convert 11110111_2 to decimal)*;

A3.2 describe how computers represent and process data using the binary number system *(e.g., binary counting, binary codes, ASCII code)*;

A3.3 derive the truth tables of the fundamental logic gates *(e.g., AND, OR, NOT, NOR, NAND, XOR)*;

A3.4 write Boolean equations for the fundamental logic gates *(e.g., for AND, the output is $Y = A \bullet B$; for OR, $Y = A + B$)*.

B. COMPUTER TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. install and configure the hardware and operating system of a workstation, and use file-management techniques effectively;

B2. construct and test simple interfaces and other electronic circuits;

B3. assemble and configure a simple computer network;

B4. install and use a variety of software;

B5. apply fundamental programming concepts to develop a variety of simple programs, including a program to control an external device.

SPECIFIC EXPECTATIONS

B1. Workstation Setup

By the end of this course, students will:

B1.1 connect and configure the hardware for a personal computer system, and install an operating system;

B1.2 describe the hardware requirements of operating systems *(e.g., processor speed and bus width, available storage space, memory size and speed)*;

B1.3 use file-management techniques to organize and back up files efficiently *(e.g., move and rename files, store files on a network drive, use file-management and backup software)*.

B2. Electronics, Robotics, and Computer Interfacing

By the end of this course, students will:

B2.1 safely construct and test electronic circuits *(e.g., LED circuit, flasher, timer)*, using both breadboard and soldering techniques to connect discrete components and/or integrated circuits;

B2.2 use appropriate procedures to prevent damage to computer hardware and electronic components *(e.g., use anti-static wrist strap and grounding mat when handling sensitive components; avoid overheating solid-state devices when soldering)*;

B2.3 describe and build an interface to connect a computer to a simple peripheral or robotic device *(e.g., LED traffic light, DC motor, robotic arm)*;

B2.4 trace the operation of a system consisting of a computer, a program, an interface, and external hardware to ensure that the interface circuit functions properly;

B2.5 use appropriate test equipment to measure electrical quantities *(e.g., voltage, resistance)*.

B3. Network Setup and Management

By the end of this course, students will:

B3.1 install and configure a peer-to-peer (P2P) network, using appropriate software and connection devices;

B3.2 enable network services *(e.g., file sharing, print services)*;

B3.3 install and use a network-enabled application or file-sharing scheme *(e.g., game, database, peer-to-peer file sharing)*.

B4. Software

By the end of this course, students will:

B4.1 describe the differences between operating systems and applications software;

B4.2 install and configure software on a workstation *(e.g., word-processing suite, driver for new hardware)*;

B4.3 use software support systems to find technical information independently *(e.g., help menu, online help, manuals)*;

B4.4 use utility software to perform basic maintenance functions *(e.g., defragment a disk drive, undelete a file, determine available space on a storage device, restore a file from a backup)*.

B5. Computer Programming

By the end of this course, students will:

B5.1 use a procedural programming language to define constants and variables, write expressions and assignment statements, and specify the order in which the operations are performed in a program;

B5.2 use input and output statements in a program *(e.g., input a name and display it onscreen)*;

B5.3 use a decision structure and a repetition structure in a program *(e.g., determine if a user is old enough to drive, run a high-low guessing game, count from a starting value to an end value)*;

B5.4 use a design process (see pp. 18–19) to plan, write, and test a computer program to control a simple robot or peripheral device *(e.g., servo motor, LED display)*.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. identify harmful effects of the widespread use of computers and associated technologies on the environment, as well as agencies that reduce these effects;

C2. identify effects of the widespread use of computers and associated technologies on society.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 identify harmful effects of computer use on the environment *(e.g., resources used and wastes created during production; disposal of old computers in landfill)*;

C1.2 identify government agencies and community partners that provide resources and guidance for environmentally sound production, use, and recycling of computer equipment *(e.g., recycling centres that accept old computers and/or batteries, companies that recycle printer cartridges or refurbish computers for resale)*.

C2. Technology and Society

By the end of this course, students will:

C2.1 identify some of the effects of the development of computer technology on society *(e.g., cheaper and faster communication in a "global village"; almost instant access to information; changes in the nature of work; telecommuting; easily accessible means of recording and maintaining knowledge and traditions of minority cultures)*;

C2.2 describe how computers are used in various occupations *(e.g., engineering calculations, architectural drawings, customer tracking and business data collection, navigation of airplanes and ships)*, and what work in these occupations would be like without computers.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. follow appropriate health and safety procedures when assembling, using, and maintaining computer systems;

D2. demonstrate an understanding of ethical and security issues related to the use of computers;

D3. identify various careers related to computer technology, and describe the education and/or training required for them.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 use appropriate equipment, procedures, and techniques *(e.g., use a wrist support, ensure power is off before opening the case of a computer, use proper lifting techniques when moving heavy equipment)* to protect health and ensure safety when working with computers *(e.g., to avoid musculoskeletal injuries, eye strain, repetitive strain injuries)*;

D1.2 identify issues related to Internet safety and personal identity security *(e.g., protection of information stored on computers or transmitted over a network, identity theft, cyberstalking, cyberbullying, privacy policies)*.

D2. Ethics and Security

By the end of this course, students will:

D2.1 demonstrate an understanding of the importance of ethical computer use *(e.g., the social cost of hacking, lost and corrupt data, and plagiarism)*;

D2.2 comply with acceptable-use policies *(e.g., protection of client information; prohibitions on unsolicited bulk mailings, transfers of copyright material, and posting of demeaning comments; safeguarding of passwords)*.

D3. Career Opportunities

By the end of this course, students will:

D3.1 identify various careers related to computer technology, and determine which ones can be entered directly from secondary school and which ones require college, university, apprenticeship, or other postsecondary training;

D3.2 identify sources of information for lifelong learning in the computer field *(e.g., trade publications, local colleges, training institutes, seminars, certification programs)*;

D3.3 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in computer technology *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D3.4 demonstrate an understanding of the Essential Skills that are important for success in the computer industry, as identified in the Ontario Skills Passport *(e.g., reading text, writing, document use, computer use, oral communication, numeracy, thinking skills)*;

D3.5 demonstrate an understanding of the work habits that are important for success in the computer industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability, organization, working independently, initiative)*;

D3.6 develop and/or select pieces of work and other materials that provide evidence of their skills and achievements in computer technology, for inclusion in a portfolio *(e.g., work logs, skills checklist, flow charts, computer programs, photographs of projects)*.

Construction Technology, Grade 10

Open TCJ2O

This course introduces students to building materials and processes through opportunities to design and build various construction projects. Students will learn to create and read working drawings; become familiar with common construction materials, components, and processes; and perform a variety of fabrication, assembly, and finishing operations. They will use a variety of hand and power tools and apply knowledge of imperial and metric systems of measurement, as appropriate. Students will develop an awareness of environmental and societal issues related to construction technology, and will explore secondary and postsecondary pathways leading to careers in the industry.

Prerequisite: None

A. CONSTRUCTION TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. describe the components and systems of buildings, the properties of various building materials, and the processes in which those materials are used;

A2. demonstrate an understanding of the safe and correct use of construction tools, equipment, and techniques;

A3. use correct terminology to describe building components and construction materials, tools, equipment, and processes.

SPECIFIC EXPECTATIONS

A1. Building Components, Materials, and Processes

By the end of this course, students will:

A1.1 identify the different components of a residential construction project *(e.g., footings, foundation, joists, studs, trusses, rafters, millwork, trim, cabinetry)*, and outline the sequence in which these components are usually installed;

A1.2 identify the various systems in a building *(e.g., foundation, framing, electrical, plumbing, cabinetry)*, and describe their functions;

A1.3 identify natural and manufactured building materials and products commonly used in the construction industry, and describe their specifications and characteristics *(e.g., **natural wood:** species, source, nominal and actual dimensions, grade; **plywood, metals, plastics:** type, grade, resistance to weather or corrosion)*;

A1.4 describe the processes used to produce common construction materials *(e.g., cutting and milling lumber and trim, gluing together the layers of plywood)*;

A1.5 list the steps of the processes used in a construction project *(e.g., **woodworking:** planing, shaping, sanding; **framing:** installing sill plates, laying out floor joists, installing subfloor)*;

A1.6 describe various processes and materials used to finish surfaces in construction projects *(e.g., applying primers, sealers, stains, varnishes, paints, veneers, laminates, and siding)*.

A2. Tools, Equipment, and Techniques

By the end of this course, students will:

A2.1 explain how to correctly and safely use, maintain, and store construction tools and equipment *(e.g., hammers, measuring instruments, table saws, mitre saws, drills, lathes, cordless drills)*;

A2.2 select the most appropriate tools or equipment for specific tasks *(e.g., wooden mallet versus framing hammer, crosscut saw versus rip saw, combination square versus framing square)*;

A2.3 describe commonly used layout, measuring, and tracing techniques *(e.g., determining and marking circumference, diameter, radius, angles, rounded corners)*;

A2.4 describe commonly used temporary and permanent assembly techniques *(e.g., **temporary:** using screws or double-headed nails; **permanent:** gluing with butt, mortise and tenon, dovetail, or mitre joints)*.

A3. Terminology

By the end of this course, students will:

A3.1 use correct terminology for the names, characteristics, and functions of construction materials, tools, and equipment in oral and written communication *(e.g., reports, lists of tools and materials, schedules, design presentations)*;

A3.2 use correct terminology to describe building components and construction processes *(e.g., **components:** header, lintel; **processes:** levelling, squaring, making plumb)*.

B. DESIGN, LAYOUT, AND PLANNING SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. design construction projects, individually or in small groups, applying a design process to plan and develop the projects and other problem-solving processes to address various related problems and challenges;

B2. use drawings to represent design ideas and solutions to technological challenges, and interpret drawings accurately when working on construction projects;

B3. apply the mathematical skills required in the planning and building of construction projects.

SPECIFIC EXPECTATIONS

B1. Design and Problem Solving

By the end of this course, students will:

B1.1 follow the steps of a design process to plan and develop a construction project *(e.g., analyse the situation or context; identify the need or problem; generate solutions to address the need; conduct research to determine constraints and availability of materials; build a model; test the model; modify the design as necessary; build the project according to the final design)* (see pp. 18–19);

B1.2 use appropriate problem-solving processes and techniques (see pp. 16–19) to address various specific problems or challenges that may arise in connection with a construction project;

B1.3 apply appropriate technological concepts *(e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems)* as they work through design and/or problem-solving processes (see pp. 5–6);

B1.4 use appropriate design elements and principles *(e.g., **elements:** line, shape, direction, space, texture, colour; **principles:** balance, scale, proportion, contrast, unity)* to enhance the appearance and functionality of construction projects;

B1.5 identify standards, regulations, and building codes that affect the design, layout, and details of construction projects *(e.g., spacing of studs in a wall, incline on access ramps, heights of counters and furniture).*

B2. Technical Drawings

By the end of this course, students will:

B2.1 produce sketches, technical drawings, and detail drawings to represent design ideas and solutions for a variety of construction projects;

B2.2 identify basic drawing conventions used in construction drawings *(e.g., scales, metric and imperial dimensioning, notes, views, line types, symbols, abbreviations)*;

B2.3 interpret technical drawings accurately when working on construction projects *(e.g., determine dimensions and materials from a drawing)*.

B3. Mathematical Skills

By the end of this course, students will:

B3.1 apply relevant mathematical concepts and formulas when preparing components of a construction project *(e.g., determine dimensions, shapes, quantities, areas, and angles)*;

B3.2 convert fractions to decimals and vice versa for typical construction tasks *(e.g., determining length, circumference, radius, diameter, perimeter, area, or volume)*;

B3.3 use appropriate metric and imperial approximations for sizes commonly used in the construction industry *(e.g., $^1/_8$ inch ≈ 3 mm)*, and find equivalents for measurements when required, using appropriate charts and tables;

B3.4 determine lengths and diameters of fastening devices needed to assemble various construction projects *(e.g., lengths and gauges of screws, nails, and staples; diameters of dowels)*, using appropriate metric and/or imperial units;

B3.5 prepare estimates, using appropriate metric and/or imperial units *(e.g., centimetres, square metres, cubic metres, litres, inches, board feet, square feet, cubic yards)*, of the materials required to complete construction projects *(e.g., volume of concrete, area of roofing, number and type of fasteners)*, and estimate the cost of these materials.

C. FABRICATION, ASSEMBLY, AND FINISHING SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. use tools, equipment, and techniques correctly and safely when preparing materials for a project;

C2. use fabrication and assembly techniques safely, accurately, and in the correct sequence;

C3. prepare surfaces and apply finishing products, trim, and hardware correctly and safely.

SPECIFIC EXPECTATIONS

C1. Technical Skills

By the end of this course, students will:

C1.1 use tools, equipment, and techniques in a correct, efficient, and safe manner to prepare project materials *(e.g., dress raw lumber; measure, cut, and square stock; drill; fasten and join)*;

C1.2 perform the various measurements required in the fabrication and assembly of a project, using appropriate metric and imperial units.

C2. Fabrication and Assembly

By the end of this course, students will:

C2.1 construct projects in accordance with specifications *(e.g., sketches, working drawings, lists of materials)*;

C2.2 fabricate and/or assemble project components in a logical and efficient sequence *(e.g., select appropriate materials and tools, follow step-by-step instructions)*;

C2.3 apply appropriate quality-control measures to ensure precise dimensions and correct assembly *(e.g., accurate cuts, clean joints, true edges)*.

C3. Finishing

By the end of this course, students will:

C3.1 prepare surfaces correctly for finish application according to type of material, desired finish, and intended use of the project *(e.g., wood species used, smooth or textured surface, environment to which surface is exposed)*;

C3.2 apply suitable finishes *(e.g., stain, paint, varnish, oil, wax)*, taking into account the type of material to be finished, the function of the finish, and the intended use of the project, and use appropriate methods to apply these finishes correctly *(e.g., brush, spray, roller)*;

C3.3 use appropriate tools, equipment, and techniques correctly and safely to install trim and hardware *(e.g., baseboards, moulding, hinges, pulls)*.

D. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of ways in which the construction industry affects the environment;

D2. describe ways in which the construction industry affects society.

SPECIFIC EXPECTATIONS

D1. Technology and the Environment

By the end of this course, students will:

D1.1 describe the major effects of the construction industry on the environment *(e.g., non-sustainable logging causing deforestation; water and air pollution released during the production of manufactured building materials; landfills required for the disposal of construction waste; energy required to produce and transport construction materials)*;

D1.2 identify the environmental impact of producing and using natural and manufactured construction materials *(e.g., deforestation and loss of animal habitat; release of arsenic from pressure-treated wood and formaldehyde from oriented-strand board [OSB] and medium-density fibreboard [MDF])*;

D1.3 identify ways of reducing the environmental impact of a structure *(e.g., ground-source heating and cooling, improved insulation, building-envelope systems, technologies to reduce light and noise pollution, energy-conserving lighting, non-toxic building materials, use of local materials)*;

D1.4 apply best practices for sustainable construction and building *(e.g., use efficient cutting patterns to minimize waste; reduce, reuse, or recycle materials)*.

D2. Technology and Society

By the end of this course, students will:

D2.1 identify the economic and social effects of the construction industry on society *(e.g., local primary and secondary employment opportunities, quality of life; effects of logging on traditional hunting by Aboriginal communities)*;

D2.2 describe the economic and social consequences of recent changes in the construction industry *(e.g., the effects of automation, manufactured housing, and globalization on employment and costs)*.

E. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

E1. identify and follow health and safety regulations, standards, and procedures related to the construction industry;

E2. identify career opportunities in the construction industry, and describe the training required for these careers.

SPECIFIC EXPECTATIONS

E1. Health and Safety

By the end of this course, students will:

E1.1 identify laws, regulations, standards, regulatory agencies, and advocacy bodies related to health and safety in the construction industry *(e.g., Workplace Safety and Insurance Board [WSIB], Ministry of Labour, Construction Safety Association of Ontario)*;

E1.2 identify hazards related to materials, processes, and equipment used in construction *(e.g., flammable solvents, toxic chemicals, sharp blades, moving parts in machinery)*, as well as resources and methods for reducing these hazards *(e.g., Workplace Hazardous Materials Information System [WHMIS], safe handling and operating practices, personal protective equipment)*;

E1.3 demonstrate an understanding of and adhere to safety practices and procedures for facilities, processes, materials, tools, and equipment used in construction *(e.g., use of tool and equipment guards)*;

E1.4 describe the rights and responsibilities of employees *(e.g., the right to know, the right to refuse, the right to participate, as outlined in the Occupational Health and Safety Act [OHSA])*;

E1.5 use protective clothing, gear, and equipment appropriately *(e.g., dust mask, safety glasses)*.

E2. Career Opportunities

By the end of this course, students will:

E2.1 describe the various sectors in the construction industry *(e.g., residential, industrial, commercial, institutional, civil, repair and maintenance)*;

E2.2 identify different careers in the construction industry *(e.g., cabinet maker, mason, electrician, plumber, project manager, estimator, developer, architect)*, and describe the secondary school pathways *(e.g., courses, programs, experiential learning opportunities)* that provide preparation for these careers;

E2.3 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the construction industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

E2.4 demonstrate an understanding of the Essential Skills that are important for success in the construction industry, as identified in the Ontario Skills Passport *(e.g., reading text, document use, measurement and calculation)*;

E2.5 demonstrate an understanding of the work habits that are important for success in the construction industry, as identified in the Ontario Skills Passport *(e.g., working safely, reliability, teamwork)*;

E2.6 develop and/or select pieces of work and other materials that provide evidence of their skills and achievements in the construction industry, for inclusion in a portfolio *(e.g., work logs, skills checklist, drawings and/or photographs of projects)*.

Green Industries, Grade 10

Open — THJ2O

This course introduces students to the various sectors of the green industries – agriculture, forestry, horticulture, floristry, and landscaping. Using materials, processes, and techniques commonly employed in these industries, students will participate in a number of hands-on projects that may include plant or animal propagation; production, maintenance, and harvesting activities; the development of floral or landscaping designs; and/or related construction activities. Students will also develop an awareness of environmental and societal issues related to green industry activities, learn about safe and healthy working practices, and explore secondary and postsecondary education and training pathways and career opportunities in the various industry sectors.

Prerequisite: None

A. GREEN INDUSTRY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of plant and/or animal biology and species classification as they relate to the green industries;

A2. describe the factors affecting the growth and care of plants and/or animals;

A3. demonstrate an understanding of design procedures and applications and production processes and systems as they relate to the green industries;

A4. demonstrate competence in the use of mathematical, documentation, and communication skills as they apply to the green industries.

SPECIFIC EXPECTATIONS

A1. Basic Biology

By the end of this course, students will:

A1.1 describe the key distinguishing characteristics of different plant and/or animal groups *(e.g., shrubs, trees, annuals, flowers, animal breeds)*;

A1.2 identify the basic components of common plants and/or animals and describe their functions *(e.g., leaves, flowers, bark, internal organs)*;

A1.3 describe important physiological processes in plants and/or animals *(e.g., germination, photosynthesis, reproduction, digestion)*.

A2. Factors Affecting Growth

By the end of this course, students will:

A2.1 describe environmental factors that affect growth and post-harvest quality *(e.g., light, temperature, soils, nutrients, water, wind)*;

A2.2 describe biological factors that affect growth and post-harvest quality *(e.g., plant type, photosynthesis, genetics)*;

A2.3 identify a variety of pests and diseases *(e.g., Asian long-horned beetle, thrips, grubs, moles, Dutch elm disease, mastitis, hoof-and-mouth disease)* and describe their effects on plants and/or animals.

A3. Designs, Processes, and Systems

By the end of this course, students will:

A3.1 describe the steps in applying a design or problem-solving process to green industry tasks (see pp. 16–19);

A3.2 identify a variety of design concepts and production processes and systems used in the green industries *(e.g., simple garden designs, floral designs, greenhouse production layouts, barn layouts, lumber grading systems, sow operations, grape production)*;

A3.3 demonstrate an understanding of a variety of processes used in plant and/or animal care *(e.g., plant growth experiments, propagation, pruning, sheep shearing)*;

A3.4 identify and describe a variety of structural or mechanical systems used within the green industries *(e.g., systems for heating, cooling, storage, irrigation, fertilizing, feeding, harvesting, cleaning, milling)*.

A4. Technological and Mathematical Literacy and Communication Skills

By the end of this course, students will:

A4.1 demonstrate an understanding of terminology used in the green industries and use it correctly in oral and written communication *(e.g., hardwood, propagation, line flower, vine, topsoil)*;

A4.2 identify sources of information about techniques and best practices in the green industries *(e.g., government reports and fact sheets; news articles; manufacturers' catalogues, manuals, and fact sheets; industry newsletters; industry events; Internet information)*;

A4.3 use imperial and metric units of measurement correctly and make accurate calculations and measurements for various applications in the green industries *(e.g., land area, volume, distance, scaling, pacing, weight, unit conversions, tree height)*.

B. GREEN INDUSTRY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. apply effective design and production practices as they relate to a variety of green industries;

B2. demonstrate competence in applying introductory technical skills used in the green industries.

SPECIFIC EXPECTATIONS

B1. Design and Production

By the end of this course, students will:

B1.1 demonstrate the ability to use fundamental skills required in green industry design and planning processes *(e.g., prepare a site inventory, create a base plan for a layout, complete a two-dimensional survey, create a floral design, use plan symbols, interpret a plan)*;

B1.2 demonstrate competence in applying techniques related to the propagation and growth of plants and/or the breeding and growth of animals *(e.g., seeding, hatching eggs, making cuttings)*;

B1.3 demonstrate competence in the application of a production process used in the green industries *(e.g., foundation planting, pasteurization, inspection, electronic sorting, transplanting)*;

B1.4 apply techniques relating to the maintenance, care, and handling of plants and/or animals, using environmental best practices *(e.g., mulching gardens, feeding and watering, product processing, visual inspection)*.

B2. Technical Skills

By the end of this course, students will:

B2.1 complete a variety of green industry projects and tasks using appropriate tools, equipment, and materials *(e.g., make a hand-tied bridal bouquet, prune a tree, scale a log, transplant a shrub, create a walkway, design a butterfly garden)*;

B2.2 demonstrate competence in the application of fundamental construction skills *(e.g., selecting materials, measuring, cutting, joining)* to a variety of construction projects *(e.g., hard construction, laying pavers and flagstones, constructing a garden, building storage bins, creating a display booth)*;

B2.3 interpret simple working drawings *(e.g., garden sketches, plans for a forest, field plot designs, greenhouse drawings)*.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. identify the impact of green industries on the environment and describe ways of minimizing harmful effects;

C2. describe the societal implications of current practices and trends in the green industries;

C3. describe the relationship of a variety of green industries to the local communities in which they operate.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 identify ways in which green industry activities affect the environment *(e.g., contamination of water by fertilizers, pesticides, and manure; emission of greenhouse gases from animals, tilled soils, and equipment; emission of air pollutants from gasoline- and diesel-powered machinery; noise pollution; high energy demand)*;

C1.2 identify best management practices, environmentally sustainable practices, and technologies that can be used to reduce the harmful effects of green industry operations *(e.g., composting, recycling, use of renewable energy sources, land retirement, minimal use of fertilizers and pesticides)*.

C2. Technology and Society

By the end of this course, students will:

C2.1 describe the societal and economic implications of recent innovations and trends in the green industries *(e.g., mechanization and its effects on productivity and employment, expanded distribution systems and their consequences for consumer choice and local production, transgenic plants and their effects on food cost and availability)*;

C2.2 identify ethical issues related to the green industries *(e.g., animal welfare, breeding of animals for fur, animal cloning, migrant labour, monopoly control of food production as a possible consequence of the use of genetically modified crops)*.

C3. Local Industries

By the end of this course, students will:

C3.1 identify local green industries *(e.g., large-scale farms, greenhouse operations, florists, community gardens, golf courses)* and describe their activities or products within a specific region;

C3.2 describe the relationships between a variety of local green industries and their local outlets *(e.g., garden centre and nursery, vegetable production and farmers' market, maple syrup production and specialty food store, flower producer and florist)*;

C3.3 describe the effects of local green industries on the community *(e.g., effects on employment, water and air quality, leisure opportunities, aesthetics; availability of locally produced specialty products)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and comply with occupational health and safety standards;

D2. identify careers in the green industries and describe the skills, education, and training required for entry into these positions.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify the personal protective clothing and equipment needed to perform various green industry tasks safely, and use as required to ensure their own and others' safety in the work environment;

D1.2 demonstrate an understanding of appropriate uses, safe operating practices, and correct maintenance procedures for materials, tools, and equipment that are commonly used in the green industries *(e.g., lawn maintenance equipment, garden tools, chainsaws, skidding equipment, mechanical harvesting equipment, milking machines, feeding systems)*;

D1.3 identify potential hazards *(e.g., trip hazards, environmental conditions, danger zones)* related to the materials, site conditions, and equipment used in the work environment;

D1.4 demonstrate an understanding of and apply safe shop and site practices *(e.g., using correct lockout procedures, using equipment guards, holding shop orientation sessions, having sanitary wash stations available, cleaning up spills and leaks when they happen, keeping areas clean and clear of obstruction, storing materials and equipment neatly and safely)*;

D1.5 identify and comply with legislation, regulations, and guidelines pertaining to the health and safety of workers in the green industries *(e.g., Occupational Health and Safety Act [OHSA], Workplace Hazardous Materials Information System [WHMIS])*.

D2. Career Opportunities

By the end of this course, students will:

D2.1 describe career opportunities in a variety of sectors in the green industries *(e.g., landscape architect, arborist, forester, florist, horticulturalist, farmer, herder)* and the education, training, and certification required for employment in green industry occupations *(e.g., training in first aid, CPR, and WHMIS; driver's licence; cut skid certification)*;

D2.2 identify ways of acquiring knowledge and experience in green industry occupations *(e.g., through part-time work experience, cooperative education, guest speakers, field trips, job shadowing)*;

D2.3 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the green industries *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D2.4 demonstrate an understanding of the Essential Skills that are important for success in the green industries, as identified in the Ontario Skills Passport *(e.g., reading text, writing, document use, computer use, oral communication, numeracy, thinking skills)*;

D2.5 demonstrate an understanding of the work habits that are important for success in the green industries, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability, organization, working independently, initiative, self-advocacy, customer service)*;

D2.6 develop and/or select pieces of work and other materials that provide evidence of their skills and achievements in areas related to the green industries, for inclusion in a portfolio *(e.g., work logs, skills checklist, résumé, references, safety certificates)*.

Hairstyling and Aesthetics, Grade 10

Open TXJ2O

This course presents hairstyling, make-up, and nail care techniques from a salon/spa perspective. Using materials, processes, and techniques used in the industry, students learn fundamental skills in hairstyling, giving manicures and facials, and providing hair/scalp analyses and treatments. Students will also consider related environmental and societal issues, and will explore secondary and postsecondary pathways leading to careers in the field of hairstyling and aesthetics.

Prerequisite: None

A. HAIRSTYLING AND AESTHETICS FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of the structure and characteristics of hair, skin, and nails;

A2. describe a variety of common products, tools, and procedures that are used in the care of hair, skin, and nails;

A3. demonstrate an understanding of lifestyle choices, attitudes, and behaviours that are important for personal and professional success in the hairstyling and aesthetics workplace.

SPECIFIC EXPECTATIONS

A1. Hair, Skin, and Nails

By the end of this course, students will:

A1.1 describe the structure of the hair *(e.g., medulla, cortex, papilla)*, skin (*e.g., follicle, sebaceous gland, eccrine gland)*, and nails *(e.g., eponychium, lunula, matrix, free edge)*;

A1.2 describe different characteristics of hair, skin, and nails that affect styling and treatment needs and options *(e.g., porosity, elasticity, texture, density, growth patterns, protection, pigmentation)*.

A2. Products, Tools, and Procedures

By the end of this course, students will:

A2.1 describe common hairstyling and aesthetics products and their uses *(e.g., shampoos, conditioners, styling agents, skin care products, nail care products, make-up products, colouring agents)*;

A2.2 describe various processes and equipment that are used in the hairstyling and aesthetics industry *(e.g., **processes:** spiral curl ironing, updos, round-brush blow drying, French braiding, facials, manicures, make-up applications, hair removal; **equipment:** flat iron, cuticle pusher, razor)*;

A2.3 apply literacy skills *(e.g., to read manufacturers' instructions)* and mathematical skills *(e.g., to measure volume and/or proportions)* to ensure the safe and appropriate use of hairstyling and aesthetics techniques, tools, and products.

A3. Lifestyle, Attitudes, and Behaviours

By the end of this course, students will:

A3.1 explain how personal well-being and professional success are enhanced by a healthy lifestyle *(e.g., adequate sleep, proper nutrition, regular exercise, a holistic approach to well-being as found in Aboriginal cultures)*;

A3.2 identify key attitudes and behaviours that contribute to success in the hairstyling and aesthetics workplace *(e.g., **attitudes:** commitment to job, respect for different viewpoints, respect for cultural diversity; **behaviours:** professional dress, regular attendance, respect for confidentiality)*.

B. HAIRSTYLING AND AESTHETICS SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. perform a variety of salon/spa services, using appropriate tools and products in a professional and safe manner;

B2. use knowledge of design elements and principles in the contexts of hairstyling and aesthetics services and marketing;

B3. apply methods for meeting the needs of the salon/spa clientele.

SPECIFIC EXPECTATIONS

B1. Performing Salon/Spa Services

By the end of this course, students will:

B1.1 select safe and appropriate materials, tools, and products and use them correctly to perform professional salon/spa services;

B1.2 identify appropriate sterilization and sanitation products and equipment and use them correctly when providing salon/spa services *(e.g., disinfectants, antiseptics, wet sanitizer, ultra-violet-ray sanitizer, autoclave)*;

B1.3 comply with workplace health and safety regulations in handling salon/spa products and equipment *(e.g., regulations for handling and storing chemicals, preventing harm from spills and vapour emissions, wearing personal protective equipment)*;

B1.4 apply appropriate ergonomic principles in the workplace by adjusting equipment and tools properly to help maintain good posture while working *(e.g., setting chairs to proper height, using a mannequin stand extension)*;

B1.5 perform a variety of hairstyling and aesthetics procedures *(e.g., **hairstyling:** thermal styling, wet styling, shampooing, hair and scalp treatments; **aesthetics:** manicures, nail tips, facials, make-up, hair removal)* for a variety of purposes/occasions *(e.g., for peer modelling events, client days, musicals, drama productions, fashion shows, charity events)*.

B2. Using Knowledge of Design

By the end of this course, students will:

B2.1 use knowledge of elements of design *(e.g., space, line, direction, colour)* to plan hairstyling and aesthetics strategies;

B2.2 use knowledge of design principles *(e.g., proportion, balance, emphasis)* to sketch, create, and produce a variety of pleasing/interesting salon/spa styles and effects *(e.g., in nail art, make-up, eyebrow shapes, hairstyles)*;

B2.3 use design knowledge and skills creatively in a variety of hairstyling and aesthetics marketing contexts *(e.g., showcase and/or bulletin board displays; displays on seasonal, fantasy, bridal themes; men's styling promotions; promotions for a school prom or theatrical production; use of Aboriginal designs to market to the Aboriginal community)*.

B3. Meeting the Needs of Clients

By the end of this course, students will:

B3.1 communicate and interact effectively with clients *(e.g., use active listening and questioning; observe rules of conversational and professional etiquette)*;

B3.2 conduct service and product consultations to identify the hairstyling and aesthetics services to be provided *(e.g., interview potential clients and record their information, noting relevant medical information such as allergies)*;

B3.3 incorporate fashion trends and new technologies into salon/spa services *(e.g., new styles, products, and techniques featured by fashion magazines, in trade shows, on the Internet, and by guest speakers)*.

C. INDUSTRY PRACTICES, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. describe ways in which hairstyling and aesthetics products and activities can affect the environment, and ways to reduce harmful effects;

C2. demonstrate an understanding of trends and social issues in relation to the hairstyling and aesthetics industry.

SPECIFIC EXPECTATIONS

C1. Industry Practices and the Environment

By the end of this course, students will:

C1.1 identify some environmental effects of various products used in the hairstyling and aesthetics industry *(e.g., **toxic substances:** peroxide, chemical relaxers, lighteners; **non-biodegradable substances:** plastic; **organic/natural substances:** facial masks, olive oil)*;

C1.2 describe how salons and spas can help to protect the environment *(e.g., purchase sustainable products, such as refillable containers, products with natural ingredients, non-toxic cleaning products, and energy-saving products; adopt environmentally friendly methods of managing waste, such as recycling and waste-reduction programs)*.

C2. Industry Practices and Society

By the end of this course, students will:

C2.1 describe some key social issues that are of concern to the hairstyling and aesthetics industry *(e.g., the use of animal testing in product development; the use of natural versus synthetic ingredients in product development; demand for scent-free and hypoallergenic products; cultural protocols, such as the Anishinaabe practice of collecting cut hair to dispose of in a culturally acceptable way)*;

C2.2 identify some new technologies in hairstyling and aesthetics and describe how they are changing the industry *(e.g., image design software, hair and nail extensions, airbrushing)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. comply with occupational health and safety standards in performing salon/spa services;

D2. describe career opportunities in hairstyling and aesthetics, including relevant secondary and post-secondary educational pathways, and identify key knowledge, skills, attitudes, and habits that are important for success in the industry.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 use safe and sanitary work practices in performing hairstyling and aesthetics services *(e.g., develop an inspection program and a safety checklist for tools and equipment; label products correctly; use a fresh towel for every customer; keep floors swept and dry)* and identify potential problems related to working in an unsanitary or unsafe work environment *(e.g., possibility of infection from contaminated instruments; danger of slipping on wet floor)*;

D1.2 describe common health and medical issues that may arise during hairstyling and aesthetics procedures *(e.g., burns, cuts, abrasions, electric shock, heat exhaustion, fainting, nose bleeds)*;

D1.3 identify laws, regulations, and regulatory/oversight organizations that govern the hairstyling and aesthetics industry *(e.g., Occupational Health and Safety Act [OHSA], Workplace Hazardous Materials Information System [WHMIS], Apprenticeship and Certification Act [Restricted Skill Sets], Food and Drugs Act – Cosmetic Regulations; Canadian Centre for Occupational Health and Safety)*.

D2. Career Opportunities

By the end of this course, students will:

D2.1 identify career opportunities in the hairstyling and aesthetics industry *(e.g., hairstylist, make-up artist, nail technician, registered massage therapist, para-medical aesthetician, holistic therapist, electrologist, salon/spa owner, teacher, sales and marketing coordinator)* and the secondary and postsecondary pathways (i.e., selection of courses, training programs, experiential learning opportunities, certifications, and/or apprenticeship) that lead to the various careers;

D2.2 identify ways in which volunteering, community service, networking, part-time work, and other extra-curricular activities can help them acquire knowledge, work habits, and skills that will contribute to their success in the hairstyling and aesthetics industry;

D2.3 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the hairstyling and aesthetics industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D2.4 demonstrate an understanding of the Essential Skills that are important for success in the hairstyling and aesthetics industry, as identified in the Ontario Skills Passport *(e.g., job task planning and organizing, decision making, problem solving)*;

D2.5 demonstrate an understanding of the work habits that are important for success in the hairstyling and aesthetics industry, as identified in the Ontario Skills Passport *(e.g., reliability, initiative, customer service)*;

D2.6 develop and/or select pieces of work and other materials that provide evidence of their skills and achievements in hairstyling and aesthetics, for inclusion in a portfolio *(e.g., work logs, skills checklist, projects, photographs of work completed)*.

Health Care, Grade 10

Open TPJ2O

This course introduces students to personal health promotion, child and adolescent health concerns, and a variety of medical services, treatments, and technologies. Students will become familiar with various instruments and equipment and will learn about human anatomy, organs, and body chemistry, as well as the effects that lifestyle choices can have on personal well-being. They will plan recreational activities for youth, perform a dietary analysis, and evaluate health care practices. Students will develop an awareness of environmental and societal issues related to health care, and will explore secondary and postsecondary pathways leading to careers in the field.

Prerequisite: None

A. HEALTH CARE FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. describe the scope and diversity of health services available in their community;

A2. describe factors that affect personal health and well-being;

A3. compare and contrast conventional and complementary therapies and their role in maintaining personal health;

A4. describe types of abuse that affect children and adolescents, and the community resources available to help victims of abuse.

SPECIFIC EXPECTATIONS

A1. Health Care Services

By the end of this course, students will:

A1.1 describe the roles and responsibilities of various health care providers *(e.g., family physicians, medical specialists, registered nurses, registered practical nurses, personal support workers, pharmacists, physiotherapists, Aboriginal traditional healers)* and facilities *(e.g., acute care facilities, long-term care facilities, mental health facilities, family practices, community outreach facilities)* in their community;

A1.2 describe community resources that provide support to children and adolescents with special needs *(e.g., schools for people who are hearing impaired, centres for people who are visually impaired, aquatic programs for children with cerebral palsy)*;

A1.3 describe the health services available in their community *(e.g., sexual health clinics, St. John Ambulance branch, crisis centres, substance abuse centres and support groups, public health family programs, Aboriginal healing centres)*.

A2. Personal Health

By the end of this course, students will:

A2.1 identify factors that affect the personal health and well-being of children and adolescents *(e.g., environmental conditions, diet, food safety, food security, adequate shelter, amount of daily exercise, amount of daily rest, recreation opportunities, work/life balance, stress)*;

A2.2 demonstrate an understanding of the nutritional needs of children and adolescents and describe the health effects of poor nutrition *(e.g., obesity, diabetes, retarded growth, reduced physical and mental efficiency)*;

A2.3 describe the benefits of different types of exercise *(e.g., aerobic versus strength conditioning)* and/or sports, and explain how a regular fitness or sports program can promote good health;

A2.4 explain the importance of having regular medical check-ups by a doctor and maintaining immunization protocols *(e.g., diphtheria, pertussis, tetanus [DPT] booster; hepatitis A/B vaccine; meningococcal vaccine; human papillomavirus [HPV] prevention vaccine; measles, mumps, rubella [MMR] vaccine; influenza vaccine)*;

A2.5 describe situations in which one should seek immediate medical advice *(e.g., allergic reactions, any illness with prolonged vomiting and diarrhea)*;

A2.6 identify and describe mental health disorders that may affect adolescents *(e.g., depression, bipolar disorder, eating disorders, schizophrenia, anxiety disorders, attention deficit disorder [ADD], disorders that are common in certain cultures)*;

A2.7 demonstrate a basic understanding of anatomy, organs, and body chemistry *(e.g., major bone and muscle structures, major organs and their location and function)*;

A2.8 explain how lifestyle choices can have an impact on an individual's health and well-being *(e.g., sleep habits; nutrition; work/life balance; use of tobacco, alcohol, prescription and illegal drugs)*;

A2.9 describe the effects of various sexually transmitted diseases *(e.g., chlamydia, genital herpes, syphilis, gonorrhea)*, and explain how lifestyle factors *(e.g., unprotected sex, multiple partners)* affect their transmission and prevention;

A2.10 develop a personal health plan that promotes healthier lifestyle choices and habits.

A3. Conventional and Complementary Therapies

By the end of this course, students will:

A3.1 compare conventional and complementary approaches to health care in terms of the therapeutic approaches used *(e.g., pharmaceutical medications versus herbal/natural remedies)* and the types of practitioners offering the services *(e.g., physicians versus homeopaths or Aboriginal healers)*;

A3.2 compare conventional and complementary treatment methods for a variety of health care issues *(e.g., nicotine patch versus acupuncture for cessation of smoking)*;

A3.3 describe the role of play, art, and music therapy in supporting the health and well-being of children and adolescents *(e.g., use of drawings to help clients communicate or cope with their feelings)*.

A4. Child and Adolescent Abuse

By the end of this course, students will:

A4.1 describe forms of physical, emotional, verbal, and sexual abuse *(e.g., hitting, bullying, name calling and put-downs, date rape, cyberbullying)*;

A4.2 identify signs of abuse *(e.g., withdrawal, isolation, aggression, sudden changes in behaviour)*;

A4.3 describe, on the basis of research, services and/or programs that are available in the local community to help children and adolescents deal with abuse and its consequences *(e.g., Kids Help Phone, student services, child therapy programs, Aboriginal Head Start)*.

B. HEALTH CARE SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. demonstrate an understanding of and apply correct procedures for ensuring asepsis, good hygiene, and proper use of medical equipment;

B2. develop and use a variety of age-appropriate recreational activities to promote safe and healthy play for children and adolescents;

B3. demonstrate an understanding of and apply sound nutritional practices, as described in Canada's Food Guide;

B4. demonstrate competence in the use of health care terminology and techniques for facilitating communication with clients;

B5. demonstrate the ability to perform basic first aid procedures.

SPECIFIC EXPECTATIONS

B1. Asepsis, Hygiene, and Equipment Use

By the end of this course, students will:

B1.1 demonstrate an understanding of and perform proper hand-washing techniques to prevent transmission of disease *(e.g., preventing the spread of rhinovirus and/or conjunctivitis)*;

B1.2 describe a variety of health care instruments and equipment and demonstrate the ability to use them correctly *(e.g., thermometer for body temperature, stethoscope for heart rate and respiration, EpiPen® for immediate treatment of allergic reaction)*;

B1.3 demonstrate an understanding of and apply safe procedures for preparing, handling, and storing food in order to reduce or eliminate contaminants *(e.g., bacteria, viruses, fungi, parasites)* and prevent disease *(e.g., salmonella or* E. coli *infections)*.

B2. Recreational Activities

By the end of this course, students will:

B2.1 create a recreational activity for either a child or an adolescent that is age appropriate and safe and that promotes a health, fitness, or social objective *(e.g., a fitness program using resistance bands or balloon volleyball for a child or adolescent with a disability, a music performance by students for an elementary school or day care centre)*;

B2.2 identify common play space hazards, and design a safe play space for children of a specific age group;

B2.3 design a game or entertainment activity that is appropriate to a specific culture and age or stage of development *(e.g., activity centre–based games for children, purposeful storytelling for multicultural celebrations)*.

B3. Nutrition and Meal Planning Using Canada's Food Guide

By the end of this course, students will:

B3.1 identify the major topics covered by Canada's Food Guide (*e.g., food groupings, food guide servings, nutritional labelling information)*, and describe the information that can be obtained from the guide and related resources *(e.g.,* Eating Well with Canada's Food Guide; Eating Well with Canada's Food Guide: First Nations, Inuit and Métis; *cultural adaptations of Canada's Food Guide available from the Ontario Public Health Association)*;

B3.2 perform a personal dietary analysis and suggest changes to personal dietary habits, using criteria presented in Canada's Food Guide *(e.g., portion size and caloric intake)*;

B3.3 design a menu that is suited to the needs of children or adolescents at a particular stage of development, that uses foods from the four food groups of Canada's Food Guide, and that is appropriate to the needs of a specific cultural group.

B4. Communication Techniques

By the end of this course, students will:

B4.1 demonstrate an understanding *(e.g., through role play, simulation, or case studies)* of the importance of both verbal and non-verbal communication techniques *(e.g., **verbal:** questioning, active listening; **non-verbal:** body language, sign language, reading Braille)*;

B4.2 describe linguistic and cultural communication barriers *(e.g., concepts of personal space [how close you stand to someone], avoidance of eye contact, women not speaking to men)*, and apply techniques for overcoming them *(e.g., using action signs to communicate with those who can't speak or read English, using a well-organized message)*;

B4.3 demonstrate the ability *(e.g., through role play)* to apply a conflict resolution approach, and list the benefits of conflict resolution skills;

B4.4 demonstrate an understanding of common health care terms *(e.g., resuscitation, anaphylactic shock, syringe, stethoscope, immunization, therapy, asepsis, malnutrition)*, and use them correctly in oral and written communication.

B5. First Aid

By the end of this course, students will:

B5.1 demonstrate competence *(e.g., through role play)* in emergency scene management and in the performance of cardiopulmonary resuscitation (CPR) and interventions for choking and anaphylactic shock;

B5.2 demonstrate competence *(e.g., through role play)* in using procedures for controlling bleeding and treating cuts, abrasions, sprains, fractures, burns, and loss of consciousness.

C. HEALTH CARE, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of environmental issues related to health care and personal well-being;

C2. describe social trends and health care issues relating to children and adolescents.

SPECIFIC EXPECTATIONS

C1. Health Care and the Environment

By the end of this course, students will:

C1.1 identify current environmental issues and describe their implications for human health and well-being *(e.g., air quality and respiratory disease, water quality and gastrointestinal problems, toxic substances and cancer or birth defects)*;

C1.2 describe the impact of health-related choices on the environment, and create a plan for improving personal health and fitness that also benefits the environment *(e.g., walking or biking rather than driving; eating more locally produced fruits and vegetables and less meat and processed food)*.

C2. Health Care and Society

By the end of this course, students will:

C2.1 identify current child and adolescent health issues from recent media coverage *(e.g., lack of exercise, poor diet, and child obesity; adult alcoholism and fetal alcohol syndrome; poverty and malnourishment)*;

C2.2 describe current issues related to the delivery of health care services in Canada *(e.g., standards, access to care, waiting times; lack of health care support, sanitation, and clean water in remote communities)*;

C2.3 identify current child and adolescent health issues in developing countries from recent media coverage *(e.g., malnutrition, lack of effective immunization programs, lack of clean water)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. identify and apply health and safety legislation and safe working practices relating to the health care industry;

D2. identify and describe career opportunities in health care and the postsecondary education and training required for entry into these occupations.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify and explain the importance of legislation, regulations, information systems, and oversight bodies concerned with protecting the health and safety of workers in the health care workplace *(e.g., Occupational Health and Safety Act [OHSA], Workplace Hazardous Materials Information System [WHMIS], Workplace Safety and Insurance Board [WSIB])*;

D1.2 comply with legislation, regulations, and standards pertaining to health and safety in the workplace;

D1.3 demonstrate an understanding of and apply safe procedures for the use of tools and equipment, as outlined in safety manuals, operating instructions, and institutional requirements;

D1.4 use protective clothing and equipment as required to keep themselves and others safe and free from harm.

D2. Career Opportunities

By the end of this course, students will:

D2.1 identify career opportunities in the health care field and describe the roles and responsibilities of workers in these occupations *(e.g., dentists, laboratory technologists, nurses, paramedics, recreational therapists, nutritionists, early childhood educators, massage therapists, pediatricians)*;

D2.2 describe the postsecondary education, training, and certification required for entry into a variety of health care careers;

D2.3 identify opportunities for volunteering in the health care field, including child-related services, and identify possible requirements *(e.g., immunization and TB testing, safety training, completion of an orientation program, police record check)*;

D2.4 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the health care industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D2.5 demonstrate an understanding of the Essential Skills that are important for success in the health care industry, as identified in the Ontario Skills Passport *(e.g., reading text, finding information, problem solving)*;

D2.6 demonstrate an understanding of the work habits that are important for success in the health care industry, as identified in the Ontario Skills Passport *(e.g., working safely, self-advocacy, organization)*;

D2.7 develop and/or select pieces of work and other materials that provide evidence of their skills and achievements in health care, for inclusion in a portfolio *(e.g., work logs, skills checklist, assignments, projects)*.

Hospitality and Tourism, Grade 10

Open — TFJ2O

This course provides students with opportunities to explore different areas of hospitality and tourism, as reflected in the various sectors of the tourism industry, with an emphasis on food service. Students will study culinary techniques of food handling and preparation, health and safety standards, the use of tools and equipment, the origins of foods, and event planning, and will learn about tourism attractions across Ontario. Students will develop an awareness of related environmental and societal issues, and will explore secondary and postsecondary pathways leading to careers in the tourism industry.

Prerequisite: None

A. HOSPITALITY AND TOURISM FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of the field of hospitality and tourism, in terms of services and products offered in the various sectors of the tourism industry;

A2. demonstrate an understanding of tools and equipment commonly used in the various sectors of the tourism industry;

A3. identify and describe common ingredients used in food preparation.

SPECIFIC EXPECTATIONS

A1. Services and Products of the Tourism Industry

By the end of this course, students will:

A1.1 identify the various sectors of the tourism industry *(e.g., accommodations, recreation and entertainment, food and beverage services, transportation, travel services)*;

A1.2 describe the services and products offered in each sector of the tourism industry *(e.g., **accommodations:** single room, suite, residence; **recreation and entertainment:** event planning, sporting event; **food and beverage services:** restaurant dining; **transportation:** air travel, car rental; **travel services:** trip planning, guided tours)* and explain how these sectors are interrelated;

A1.3 describe various types of accommodations *(e.g., hotel, motel, bed and breakfast)*;

A1.4 identify common symbols used for classification purposes in the tourism industry *(e.g., five-diamond award system, used by the Canadian and American Automobile Associations; three-star award system, used by the Michelin Guide)* and explain the factors that determine the rating of a tourist accommodation facility *(e.g., location, cleanliness, quality of service, value)*;

A1.5 identify the types of tourist attractions associated with the various geographic regions of Ontario *(e.g., wineries in the Niagara region, ecotourism in northern Ontario, museums and art galleries in Ottawa, sporting events and conventions in major urban areas)*;

A1.6 identify province-wide tourist activities and attractions in Ontario *(e.g., seasonal festivals, cultural events, areas of natural beauty, historical sites, fishing and hunting, Aboriginal powwows)*;

A1.7 identify tourist activities and attractions in local communities in Ontario *(e.g., fall fairs, homecoming events, minor sports tournaments, restaurants, hotels)*;

A1.8 describe the various types of tourism markets *(e.g., domestic and international, inbound and outbound)*.

A2. Tools and Equipment

By the end of this course, students will:

A2.1 identify tools and equipment commonly used in the various sectors of the tourism industry *(e.g., point-of-sale [POS] systems, ovens, washing machines, cash registers, uniforms)*;

A2.2 describe proper procedures for using a variety of tools and equipment commonly used in various sectors of the tourism industry *(e.g., knives, mixers, steamers, deep fryers, ovens, coffee-making systems, vacuum cleaners, reservation systems)*;

A2.3 identify and describe the measurement systems based on metric, US customary, and British imperial units, and explain how these systems affect the use of tools and equipment commonly used in the tourism industry.

A3. Common Ingredients in Food Preparation

By the end of this course, students will:

A3.1 identify the main ingredients used in food preparation *(e.g., types of flour, herbs, spices, vegetables, meats, fruits)* and describe their characteristics *(e.g., colour, taste, texture, aroma)*;

A3.2 identify the origin or source of various food ingredients *(e.g., geographical origin or source, type of plant or animal from which they come, raw materials used in their manufacture)* and describe their use in the cuisine of various cultures *(e.g., Aboriginal use of wild rice)*;

A3.3 classify foods and ingredients by their type *(e.g., proteins [meat], vegetables, fats [oils, lard], carbohydrates [fruit, grains])*, nutritional value, and recommended daily intake, as noted in *Eating Well with Canada's Food Guide* (2007).

B. HOSPITALITY AND TOURISM SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. use tools and equipment in accordance with industry standards;

B2. demonstrate the use of safe and correct culinary techniques in the preparation, cooking, and presentation of food, and demonstrate professional serving methods;

B3. demonstrate effective use of forms of information and communications technology commonly used in the various sectors of the tourism industry;

B4. demonstrate an understanding of the elements of planning an event or activity.

SPECIFIC EXPECTATIONS

B1. Using Tools and Equipment

By the end of this course, students will:

B1.1 select the appropriate tools or equipment for assigned tasks *(e.g., knives, steamer, mixer, proofer, computer, washing machine, vacuum cleaner)*, and demonstrate the ability to use them safely and correctly;

B1.2 use metric, US customary, and British imperial measuring tools *(e.g., scales, measuring cups)* correctly when following standardized recipes and baking formulas;

B1.3 apply standard industry practices *(e.g., mise en place, three-sink method, use of equipment guards and safety features, "clean as you go" system)* when using tools and equipment to prepare and serve food and clean up afterwards.

B2. Culinary Techniques and Serving Methods

By the end of this course, students will:

B2.1 apply food preparation methods *(e.g., thawing, cooking, freezing)* appropriately and correctly;

B2.2 apply food handling procedures and techniques *(e.g., using the "first in, first out" method when selecting ingredients; peeling; washing; panning)* appropriately and correctly;

B2.3 use a variety of cutting techniques *(e.g., **precision cuts:** large dice, medium dice, small dice, brunoise, rondelle, paysanne, batonnet, julienne, fine julienne; **butchery and fabrication:** deboning, cleaning, filleting)* correctly *(e.g., keeping all items a consistent size)* and safely for a variety of food preparations;

B2.4 apply a variety of cooking methods *(e.g., dry heat, moist heat, combination)* correctly when preparing food, using proper cooking temperatures as specified in provincial regulations;

B2.5 apply a variety of baking methods *(e.g., creaming method, straight dough method)* correctly when preparing bakery products;

B2.6 create simple meals from various culinary traditions *(e.g., French Canadian, Aboriginal, Italian, East Asian)*, with appropriate functional garnishes *(e.g., lemon, parsley, radish flower; chocolate drizzle on dessert, berries on wild rice)*;

B2.7 identify recipes that accommodate a variety of specific customer needs *(e.g., the needs of diabetic, vegan, or lactose-intolerant customers, or customers requiring a sodium-free diet)*;

B2.8 demonstrate the use of professional table service etiquette *(e.g., serve from the right, pay attention to customer signals, serve customers in the appropriate order)*;

B2.9 set a table in an appropriate manner *(e.g., paying attention to the choice and arrangement of utensils and glassware, the design of the centrepiece, the way napkins are folded, and the number of place settings required)* to suit the circumstances.

B3. Information and Communications Technology

By the end of this course, students will:

B3.1 use information and communications technology to facilitate teamwork, time management, and work organization *(e.g., electronic message minder to facilitate time management, trip planner to facilitate organization, organizational charts to facilitate teamwork)*;

B3.2 demonstrate effective use of a variety of software applications to perform and manage a variety of tasks *(e.g., use word processing to produce a menu, use the Internet to search for recipes, input ingredients into a spreadsheet, create graphics for advertising, create a slide show presentation for customers)*;

B3.3 explain how advances in information and communications technology have affected the availability of products and services in the tourism industry *(e.g., products and services can be ordered over the Internet)*.

B4. Planning an Event or Activity

By the end of this course, students will:

B4.1 select a successful local tourist event *(e.g., music festival, winter carnival, sporting event)* and outline the planning, organizational, and delivery details that are involved in running the event;

B4.2 design a tourism event or activity *(e.g., reception, ski vacation, fishing trip, catered event)* that meets a customer's specific needs;

B4.3 develop an itinerary or schedule for a tourism event or activity *(e.g., corporate outing, cruise vacation, sporting event, cultural festival)*;

B4.4 create a cost summary for a tourism event or activity *(e.g., itemizing the cost of tickets, meals, travel, taxes)*.

C. INDUSTRY PRACTICES, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of ways in which various aspects of the tourism industry affect the environment, and ways in which harmful effects can be reduced;

C2. demonstrate an understanding of ways in which various aspects of the tourism industry affect society.

SPECIFIC EXPECTATIONS

C1. Industry Practices and the Environment

By the end of this course, students will:

C1.1 describe ways in which various aspects of the tourism industry affect the environment *(e.g., use of pesticides and fertilizers on golf courses may cause water pollution; air travel causes increased greenhouse gas emissions through the burning of jet fuel; Aboriginal lands and traditions may be affected by ecotourism; high water consumption by hotels may put a strain on the local environment)*;

C1.2 identify ways of reducing the harmful effects that various aspects of the tourism industry have on the environment *(e.g., create wildlife sanctuaries; support conservation projects; ensure that tourist facilities do not exceed the carrying capacity of the area or region; invest in carbon offsets such as planting a diversity of native trees)*;

C1.3 describe and apply appropriate conservation measures *(e.g., reduce, reuse, recycle)*;

C1.4 describe, on the basis of research, codes of ethics and/or guidelines for sustainable tourism, and use them to assess a tourism product, facility, or service.

C2. Industry Practices and Society

By the end of this course, students will:

C2.1 explain the economic and social impact of the tourism industry *(e.g., developing tourist facilities creates jobs; tourism can cause road congestion, pollution, and/or degradation of the environment; tourists bring money into the community)*;

C2.2 identify and describe the societal advantages and disadvantages of having ready access to foods imported from around the world *(e.g., **advantage:** fruits and vegetables available during the winter provide health benefits; **disadvantage:** availability of low-priced imported food hurts local food producers)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. identify and demonstrate compliance with health and safety standards in the various sectors of the tourism industry;

D2. demonstrate an understanding of the principles of customer service and professionalism;

D3. identify career opportunities in the various sectors of the tourism industry and the education and training that would best prepare them for employment in various occupations in the industry.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify the laws, regulations, and regulatory/oversight organizations that govern health, safety, and sanitary standards in the tourism industry *(e.g., Health Protection and Promotion Act [HPPA], Occupational Health and Safety Act [OHSA], Workplace Hazardous Materials Information System [WHMIS], local health departments)*;

D1.2 demonstrate an understanding of emergency preparedness *(e.g., know the location and understand the features of safety equipment such as the fire blanket, first aid kit, and eye wash station)* and procedures to be followed *(e.g., evacuation procedures)* in the event of an accident;

D1.3 use protective clothing and equipment as required to ensure their own and others' safety in the work environment;

D1.4 demonstrate appropriate and timely use of safety and sanitary practices *(e.g., washing hands, labelling containers, sanitizing work surfaces and utensils, storing perishable items appropriately, monitoring temperature control)* when handling food and beverages.

D2. Customer Service and Professionalism

By the end of this course, students will:

D2.1 identify the fundamental principles of customer service *(e.g., reliability, accountability, caring, responsiveness)*;

D2.2 describe the importance of professional appearance and conduct for success in a career in hospitality and tourism *(e.g., dress code necessary to maintain a positive image, high standards of hygiene required for customer comfort and safety, teamwork required in kitchen brigade)*;

D2.3 identify common ethical standards in customer service in the tourism industry *(e.g., standards relating to confidentiality and privacy)*.

D3. Career Opportunities

By the end of this course, students will:

D3.1 identify various types of careers that are available in different sectors of the tourism industry *(e.g., food and beverage manager, travel agent, concierge, tour operator, cruise ship purser)* and describe the secondary school pathways (i.e., selection of courses, programs, and experiential learning opportunities) that would provide the best preparation for these careers;

D3.2 describe the relationship between the tourism industry and lifestyle opportunities *(e.g., the tourism industry provides opportunities for seasonal work, shift work, employment in remote and/or scenic areas, small business ownership, and participation in recreational activities)*;

D3.3 describe similarities between skills required in various occupations in the tourism industry and their personal skills inventory;

D3.4 identify industry-recognized training and/or certifications that it would be beneficial to have if they are pursuing a career in the tourism industry *(e.g., Standard First Aid, cardiopulmonary resuscitation [CPR], Service Excellence, Safe Food Handling)*;

D3.5 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the tourism industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D3.6 demonstrate an understanding of the Essential Skills that are important for success in the tourism industry, as identified in the Ontario Skills Passport *(e.g., finding information, scheduling or budgeting and accounting, oral communication)*;

D3.7 demonstrate an understanding of the work habits that are important for success in the tourism industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability)*;

D3.8 develop and/or select pieces of work and other materials that provide evidence of their skills and achievements related to hospitality and tourism, for inclusion in a portfolio *(e.g., work logs, skills checklist, recipe list, photographs of product or service delivered)*.

Manufacturing Technology, Grade 10

Open TMJ2O

This course introduces students to the manufacturing industry by giving them an opportunity to design and fabricate products using a variety of processes, tools, and equipment. Students will learn about technical drawing, properties and preparation of materials, and manufacturing techniques. Student projects may include a robotic challenge, a design challenge, or a fabrication project involving processes such as machining, welding, vacuum forming, or injection moulding. Students will develop an awareness of environmental and societal issues related to manufacturing, and will learn about secondary and postsecondary pathways leading to careers in the industry.

Prerequisite: None

A. MANUFACTURING TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of the manufacturing industry and of processes and technologies related to manufacturing;

A2. demonstrate an understanding of how a design process is used in the planning and development of a manufacturing project;

A3. identify and explain how various materials, tools, and equipment are used in the manufacture of products.

SPECIFIC EXPECTATIONS

A1. The Manufacturing Industry

By the end of this course, students will:

A1.1 describe major differences between primary manufacturing industries *(e.g., iron and steel, lumber, paper, petroleum)* and secondary manufacturing industries *(e.g., automotive, aerospace, chemicals, plastics, textiles)*;

A1.2 identify key areas of operation in manufacturing *(e.g., design of product, production planning, fabrication of product, quality control)*;

A1.3 identify and describe production methods *(e.g., custom, assembly line, flexible, mass production)* used in the manufacture of various products;

A1.4 describe ways in which manufacturing technology affects people's daily lives *(e.g., by providing improved consumer products, developing new diagnostic equipment in health care, creating more energy-efficient means of transport)*.

A2. Design Fundamentals

By the end of this course, students will:

A2.1 identify and describe the steps of a design process used to plan and develop solutions to challenges in manufacturing technology *(e.g., describe and analyse a situation and define the specific problem or need; research criteria, constraints, and availability of materials; generate a number of possible solutions, using techniques such as brainstorming; select the optimal solution; test and evaluate the product; repeat steps as necessary)*;

A2.2 identify technological concepts *(e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems)* (see pp. 5–6) and particular environmental concerns *(e.g., pollution, disposal of waste, packaging, recycling)* that are important considerations in product design;

A2.3 describe how various forms of communication *(e.g., group discussion, brainstorming)*, graphic representation *(e.g., sketches, technical drawings, computer-aided design [CAD])*, and documentation *(e.g., research reports, design briefs)* are used in the development of project ideas.

A3. Materials, Tools, and Equipment

By the end of this course, students will:

A3.1 identify and describe the hand tools, machine tools, power tools, and equipment *(e.g., saw, drill, engine lathe, vacuum forming machine, computer hardware and software)* used in the design and fabrication of a variety of projects *(e.g., robotic challenge, design challenge, fabrication project)*;

A3.2 describe the properties and characteristics of various natural and manufactured materials *(e.g., woods, metals, plastics, ceramics, fabrics)* and their suitability for use in manufacturing;

A3.3 describe procedures for preventive maintenance and proper storage of hand tools, power tools, machine tools, and equipment used in manufacturing.

B. MANUFACTURING TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. apply an appropriate design process to plan and develop a product;

B2. develop and use a manufacturing process plan to produce a product;

B3. use hand tools, machine tools, power tools, materials, and equipment safely and correctly in the manufacture of a product;

B4. demonstrate the use of metrology skills to measure, lay out, and inspect a product.

SPECIFIC EXPECTATIONS

B1. Design Process

By the end of this course, students will:

B1.1 follow a design process that includes identification of the particular need or problem, consideration of design criteria and constraints, development of multiple solutions, selection of the optimal solution, evaluation of the product, and life cycle assessment (LCA);

B1.2 apply appropriate technological concepts (see pp. 5–6) as an integral part of the design process;

B1.3 prepare and present appropriately organized design briefs for a variety of manufacturing challenges *(e.g., briefs that contain an analysis of the challenge, design criteria, multiple solutions to the challenge, evaluation of the product)*;

B1.4 develop technical drawings *(e.g., orthographic, isometric, and assembly drawings)* and technical reports, as required in the design and manufacture of a product;

B1.5 accurately interpret technical drawings and other resources *(e.g., reports, literature, manuals)* as they design and manufacture products.

B2. Process Planning

By the end of this course, students will:

B2.1 identify and select appropriate materials required to manufacture a product;

B2.2 develop a process plan for the manufacture of a product *(e.g., create a work plan, identify appropriate tools and equipment, produce a bill of material, develop a budget for the project)*;

B2.3 use correct procedures to prepare materials for the manufacture of a product *(e.g., layout, cutting to rough length, squaring, drilling, weld preparation, deburring)*;

B2.4 use appropriate methods of assembly *(e.g., joining, bonding, crimping, fastening)* based on design criteria and specifications.

B3. Using Materials, Tools, and Equipment

By the end of this course, students will:

B3.1 set up hand tools, machine tools, power tools, and equipment *(e.g., jigs and fixtures, clamps, engine lathe, welding equipment, milling machine, drill press, injection-moulding machine)* properly in preparation for the manufacture of a product *(e.g., robotic challenge, design challenge, fabrication project)*;

B3.2 use various hand tools, power tools, machine tools, and related equipment *(e.g., saws, grinders, milling machine, engine lathe, welding equipment, vacuum-forming machine)* safely and correctly to manufacture a product;

B3.3 use the proper procedures for maintaining and storing materials, tools, and equipment;

B3.4 demonstrate safe workplace practices and behaviours *(e.g., follow instructions, keep work area clean and dry, don't distract other workers)* when using materials, tools, and equipment to manufacture a product.

B4. Metrology Skills

By the end of this course, students will:

B4.1 select and use a variety of measuring tools *(e.g., calipers, scales, micrometers)* to measure projects accurately, according to specifications;

B4.2 perform proper layout procedures;

B4.3 use an appropriate inspection technique *(e.g., statistical process control [SPC], inspection report, rubric)* to evaluate projects and ensure quality.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of ways in which the manufacturing industry affects the environment;

C2. demonstrate an understanding of ways in which the manufacturing industry affects society.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 identify ways in which manufacturing affects the environment today *(e.g., through the demand for raw materials, creation of greenhouse gases, disposal of waste materials)*, and predict how the effects will change in the future;

C1.2 explain the importance of "reduce, reuse, and recycle" and life cycle assessment (LCA) when designing, manufacturing, and marketing a product;

C1.3 use proper storage and disposal techniques of materials and waste products, ensuring that there is a minimal effect on the environment;

C1.4 explain the need for environmental stewardship and describe how the manufacturing industry can act in an environmentally responsible way *(e.g., by harvesting raw materials in a sustainable manner, using energy from renewable sources, making products that can be recycled, ensuring ethical treatment of people affected by manufacturing activities)*.

C2. Technology and Society

By the end of this course, students will:

C2.1 describe the past and present effects of manufacturing on society *(e.g., changes in work environments and lifestyle brought about by the Industrial Revolution, rising standards of living, widespread availability of consumer goods, effect of resource extraction on Aboriginal communities, effect on developing countries that accept industrialized countries' waste)*, and predict how manufacturing will affect society in the future;

C2.2 identify the economic benefits that the manufacturing industry can provide at the local and provincial levels;

C2.3 evaluate from various perspectives *(e.g., safety, technical, financial, environmental, ethical)* the effects of new and emerging manufacturing technologies *(e.g., wireless technology in cell phones and personal digital assistants [PDAs], improved materials and design in sports equipment that offer better protection, collision avoidance safety feature on motor vehicles)* on culture and society.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. identify and demonstrate compliance with health and safety legislation, standards, and procedures related to the manufacturing industry;

D2. describe career opportunities in the manufacturing industry and the education and training required for these careers.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify and explain the importance of legislation and standards related to procedures and operations used in manufacturing facilities *(e.g., Occupational Health and Safety Act [OHSA], Workplace Hazardous Materials Information System [WHMIS])* and the relevant oversight/regulatory organizations *(e.g., Workplace Safety and Insurance Board [WSIB])*;

D1.2 identify health and safety roles, responsibilities, and procedures in manufacturing *(e.g., concerning choice of equipment and materials, maintenance of equipment, storing of materials and equipment, inspection of facilities and equipment, in-service and training)*;

D1.3 demonstrate compliance with health and safety standards *(e.g., rules, procedures)* related to facilities, processes, materials, tools, and equipment *(e.g., ensure that correct fire extinguishers and blankets are accessible, appropriate equipment guards are in place, and materials and chemicals are appropriately labelled)*;

D1.4 demonstrate the safe use of tools and equipment in compliance with safety manuals, instructions, and institutional requirements;

D1.5 use protective clothing and equipment as required to ensure their own and others' safety in the work environment.

D2. Career Opportunities

By the end of this course, students will:

D2.1 identify a variety of career opportunities in the manufacturing industry;

D2.2 identify the education and training requirements for various careers in the manufacturing industry;

D2.3 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the manufacturing industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D2.4 demonstrate an understanding of the Essential Skills that are important for success in the manufacturing industry, as identified in the Ontario Skills Passport *(e.g., measurement and calculation, finding information, problem solving)*;

D2.5 demonstrate an understanding of the work habits that are important for success in the manufacturing industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability)*;

D2.6 develop and/or select pieces of work and other materials that provide evidence of their skills and achievements in manufacturing technology, for inclusion in a portfolio *(e.g., work logs, skills checklist, sketches, photographs of projects)*.

Technological Design, Grade 10

Open — TDJ2O

This course provides students with opportunities to apply a design process to meet a variety of technological challenges. Students will research projects, create designs, build models and/or prototypes, and assess products and/or processes using appropriate tools, techniques, and strategies. Student projects may include designs for homes, vehicles, bridges, robotic arms, clothing, or other products. Students will develop an awareness of environmental and societal issues related to technological design, and will learn about secondary and postsecondary education and training leading to careers in the field.

Prerequisite: None

A. TECHNOLOGICAL DESIGN FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. identify and describe the purpose, scope, and steps of a design process;

A2. identify and describe tools, strategies, and skills needed for project research, planning, and organization;

A3. demonstrate an understanding of how design ideas are represented graphically;

A4. explain the purpose of building models and prototypes, and identify tools, materials, and methods for building and testing them;

A5. demonstrate an understanding of communications methods used in the design process.

SPECIFIC EXPECTATIONS

A1. Design Process

By the end of this course, students will:

A1.1 describe the purpose of design for a given project *(e.g., cleaner energy, cost-efficient products, smaller living spaces)* in terms of key technological concepts *(e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems)* (see pp. 5–6);

A1.2 identify the steps in a design process *(e.g., define the problem or challenge, taking into account relevant contextual or background information; gather information about criteria, constraints, and available materials; generate possible solutions, using techniques such as brainstorming; choose the best solution; develop and produce a model or prototype; test the model or prototype; incorporate improvements or redesign and retest; report results)* (see pp. 18–19).

A2. Research, Planning, and Organization

By the end of this course, students will:

A2.1 identify sources of pertinent information for a project *(e.g., libraries, the Internet, trade journals)*;

A2.2 identify appropriate methods, strategies, and tools for developing designs and for planning and organizing projects and related activities *(e.g., making sketches, creating a sequence chart, using tracking sheets and checklists, using organizers and/or file management software)*;

A2.3 investigate and list the skills and work habits needed for planning and organizing a particular project *(e.g., problem solving, decision making, task planning, oral communication, finding information)*.

A3. Representing Design Ideas Graphically

By the end of this course, students will:

A3.1 identify different methods for representing design ideas graphically *(e.g., hand-drawn or computer-generated sketches, technical drawings)*;

A3.2 correctly use drafting standards, conventions *(e.g., line types and weights, dimensioning, title block information, labelling)*, and tools *(e.g., drafting curves, protractors, computer-aided design [CAD] or sketching software, templates)*;

A3.3 identify various types of technical drawings *(e.g., orthographic, pictorial, detail, and rendered drawings; floor plans; elevations; sections)*.

A4. Making and Testing Models and Prototypes

By the end of this course, students will:

A4.1 explain the purposes of building models and prototypes;

A4.2 identify a variety of tools and materials used for modelling and prototyping *(e.g., **tools:** utility knife, CAD software, foam cutter, bandsaw; **materials:** composites, textiles, metals, clay, foam board)*;

A4.3 identify key criteria for assessing designs for a given project *(e.g., functionality, size, weight, durability, aesthetics, cultural appropriateness)*;

A4.4 identify tools, equipment, and methods for testing and evaluating models and prototypes.

A5. Reporting and Presenting

By the end of this course, students will:

A5.1 correctly use key technical terms and specialized language related to various design projects;

A5.2 describe a variety of methods for recording design ideas and documenting the progress of a design project *(e.g., portfolio, journal, logs, sketchbook)*;

A5.3 identify a variety of presentation tools *(e.g., LCD projector, interactive white board, webcast)* used to communicate progress and results for a given design project.

B. TECHNOLOGICAL DESIGN SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. research, plan, and organize projects, using a design process and appropriate methods and tools;

B2. apply appropriate methods for generating and graphically representing design ideas and solutions;

B3. create and test models using a variety of techniques, tools, and materials;

B4. use suitable communication methods throughout the design process.

SPECIFIC EXPECTATIONS

B1. Research, Planning, and Organization

By the end of this course, students will:

B1.1 gather and use pertinent information *(e.g., on existing products, available materials, and other resources)* for a variety of design challenges *(e.g., human transportation device; locker organizer; light bulb remover; birchbark canoe, tikinagan, or other item made from local renewable resources)*;

B1.2 plan and organize projects and related activities, using a design process and appropriate methods and tools *(e.g., sequence chart, tracking sheet, file management)*.

B2. Developing and Representing Design Ideas

By the end of this course, students will:

B2.1 create freehand sketches of brainstormed design ideas, emphasizing key features *(e.g., shapes, texture, materials, protrusions, unusual features)*;

B2.2 apply mathematical and scientific concepts and skills as required in the course of designing various products and/or processes;

B2.3 produce hand-drafted and/or computer-based technical drawings of design solutions, using standard drafting tools and conventions.

B3. Making and Testing Models and Prototypes

By the end of this course, students will:

B3.1 use appropriate tools, equipment, and materials to create design models and/or prototypes *(e.g., **tools:** rotary tool, bandsaw, fabric shears, CAD software; **equipment:** computer, sewing machine; **materials:** paper, wax, clay, wood, metals, composites, plastics, cardboard, starch, textiles)*;

B3.2 use appropriate measuring methods and scales *(e.g., **metric:** 1:10, 1 cm:1 m or 1:100, 1:500; **imperial:** $^1/_2$":1′ or 1:24)* when creating models and prototypes;

B3.3 assess models and/or prototypes on the basis of prescribed criteria *(e.g., aesthetics, ergonomics, safety, efficiency, environmental impact)*.

B4. Reporting and Presenting

By the end of this course, students will:

B4.1 create presentations and/or design briefs using a prescribed format to document proposed design solutions;

B4.2 report and reflect on their experience with the design process, using a suitable oral and/or written format *(e.g., presentation, log, journal)*.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of environmentally responsible practices, and apply them throughout the technological design process;

C2. describe how society influences technological innovation and how technology affects society.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 identify environmental issues that affect technological design *(e.g., global climate change, resource depletion, conservation, toxins)*;

C1.2 describe and apply best practices for conserving energy and other resources during the design process *(e.g., use wood glue instead of hot glue, plan projects to make efficient use of materials and equipment, reuse and recycle prototype material)*.

C2. Technology and Society

By the end of this course, students will:

C2.1 describe how society influences the development and use of technology *(e.g., traffic congestion spurs development of compact vehicles; increasing population density leads to the construction of taller buildings; environmental awareness leads to increased use of alternative energy sources)*;

C2.2 describe how various technological innovations have affected quality of life *(e.g., pesticides, internal combustion engines, plastics, on-demand water heaters, catalytic converters, nanotechnology, wireless communication*).

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. apply appropriate health, safety, and environmental practices throughout the design process;

D2. identify careers related to technological design, and the education and training required for them.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify health and safety regulations and standards that must be considered when designing products and/or processes *(e.g., regulations and standards from the Canadian Standards Association, Ontario Building Code, and Workplace Hazardous Materials Information System [WHMIS])*;

D1.2 demonstrate an understanding of and follow personal and environmental health and safety procedures with respect to processes, materials, tools, equipment, and facilities throughout the design process and related activities *(e.g., use protective equipment; set tool and equipment guards properly; ensure adequate ventilation and ergonomic seating and other workplace arrangements; follow safe operating procedures; keep work areas clean and organized; store materials and dispose of wastes properly)*.

D2. Career Opportunities

By the end of this course, students will:

D2.1 identify a variety of career opportunities related to technological design *(e.g., engineer, architect, engineering technician, industrial designer, landscape designer, fashion designer, interior designer)*;

D2.2 identify and compare the education and/or training required for various careers in technological design *(e.g., degree, diploma, certificate, apprenticeship)*;

D2.3 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the technological design industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D2.4 demonstrate an understanding of the Essential Skills that are important for success in the technological design industry, as identified in the Ontario Skills Passport *(e.g., reading text, writing, document use, measurement and calculation)*;

D2.5 demonstrate an understanding of the work habits that are important for success in the technological design industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability, initiative, customer service, entrepreneurship)*;

D2.6 develop and/or select pieces of work and other materials that provide evidence of their skills and achievements in technological design, for inclusion in a portfolio *(e.g., work logs, skills checklist, sketches, drawings, photographs of models and prototypes, virtual models)*.

Transportation Technology, Grade 10

Open TTJ2O

This course introduces students to the service and maintenance of vehicles, aircraft, and/or watercraft. Students will develop knowledge and skills related to the construction and operation of vehicle/craft systems and learn maintenance and repair techniques. Student projects may include the construction of a self-propelled vehicle or craft, engine service, tire/wheel service, electrical/battery service, and proper body care. Students will develop an awareness of related environmental and societal issues, and will explore secondary and postsecondary pathways leading to careers in the transportation industry.

Prerequisite: None

A. TRANSPORTATION TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. explain how engines work to produce power, and identify the function and explain the maintenance requirements of the cooling, lubrication, and fuel systems;

A2. identify the major components and describe the function and operation of various types of drivetrains;

A3. identify and describe the major systems and components of vehicles, aircraft, and/or watercraft;

A4. demonstrate an understanding of the technical and mathematical knowledge and skills required to properly maintain and repair vehicles, aircraft, and/or watercraft.

SPECIFIC EXPECTATIONS

A1. Understanding Engines

By the end of this course, students will:

A1.1 identify the function and describe the construction and operation of the major parts of an engine *(e.g., piston, crankshaft, connecting rod, camshaft)*;

A1.2 explain how power is produced in the course of an engine cycle *(e.g., four-stroke cycle, two-stroke cycle, rotary cycle)*;

A1.3 identify the function and describe the liquid or air pathways and maintenance requirements of various engine cooling systems;

A1.4 identify the function and describe the construction and maintenance requirements of an engine lubrication system;

A1.5 identify the function and describe the construction and maintenance requirements of an engine fuel system.

A2. Understanding Drivetrains

By the end of this course, students will:

A2.1 describe the various types of drivetrains *(e.g., direct, gear to gear, gear and chain, continuously variable systems)*;

A2.2 identify the function and describe the operation of major drivetrain components *(e.g., transmission, clutch, differential)*;

A2.3 describe the power flow from engine to final drive *(e.g., engine to wheels, engine to propeller, engine to track)* in various types of drivetrains.

A3. Understanding Major Systems and Components

By the end of this course, students will:

A3.1 identify and describe the function of various types of steering/control systems and their components *(e.g., **systems:** rack and pinion, recirculating ball, fly-by-wire; **components:** rack, pitman arm)*;

A3.2 identify and describe the function of various types of suspension systems and their components *(e.g., **systems:** coil spring, leaf spring, torsion; **components:** coil, leaf, torsion bar)*;

A3.3 identify and describe the function of various types of brake systems and their components *(e.g., **systems:** mechanical, hydraulic, electric, pneumatic; **components:** emergency cable, wheel cylinder, magnet, brake chamber)*;

A3.4 identify and describe the function of the electrical system and its components *(e.g., battery, fuses, starter)*;

A3.5. identify and describe major body, hull, and/or fuselage system components *(e.g., fender, keel, fairing)*.

A4. Technological and Mathematical Literacy

By the end of this course, students will:

A4.1 use appropriate resources *(e.g., shop manuals, online information)* to find information as required for basic maintenance and repair of vehicles and/or craft;

A4.2 report on work in progress *(e.g., complete a work order, parts list, and/or journal)* using appropriate documentation;

A4.3 apply appropriate mathematical and/or scientific principles, procedures, and terms and symbols when conducting and/or reporting on work on vehicles and/or craft *(e.g., convert measures from US customary/British imperial units to metric units – pounds per square inch [PSI] to kilopascals [kPa], gallons to litres; calculate antifreeze-to-water ratio)*;

A4.4 use appropriate terminology for tools and equipment used in connection with vehicles and/or craft *(e.g., **hand tools:** wrenches, socket wrench sets; **power tools:** air ratchet, drill; **equipment:** battery chargers, on-board diagnostic [OBD] code readers)*;

A4.5 correctly interpret drawings that depict system components of vehicles and/or craft *(e.g., illustrations in parts lists, exploded views, technical drawings)*.

B. TRANSPORTATION TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. use problem-solving processes to design and fabricate a project that converts and uses energy, and to address various problems or challenges related to vehicles or craft;

B2. demonstrate the safe and correct use of a variety of maintenance and repair techniques for servicing powertrain components;

B3. perform basic service on various vehicle, aircraft, and/or watercraft systems and components;

B4. follow correct procedures for the preventive maintenance and care of vehicles, aircraft, and/or watercraft.

SPECIFIC EXPECTATIONS

B1. Design and Fabrication

By the end of this course, students will:

B1.1 use a problem-solving process to design and fabricate a project *(e.g., a self-propelled vehicle or craft)* that demonstrates conversion and use of energy under varying conditions *(e.g., application of mechanical advantage, varying torque and speed)*;

B1.2 use various problem-solving processes and techniques appropriately to solve problems or address challenges related to vehicles or craft;

B1.3 apply relevant technological concepts *(e.g., concepts related to materials, power and energy, mechanisms)* appropriately as they work through problem-solving processes related to vehicles or craft;

B1.4 report on the end result of the project and identify possible improvements.

B2. Maintenance and Repair Techniques

By the end of this course, students will:

B2.1 use tools required for basic service tasks related to powertrains *(e.g., hand and power tools)* correctly and maintain the tools in good working order;

B2.2 use technical and product manuals and/or software programs to identify and locate powertrain components and determine recommended service procedures and maintenance schedules;

B2.3 perform basic maintenance procedures related to powertrains *(e.g., engine oil change, basic vehicle/craft inspection, blade or cutting-tool sharpening)* safely and correctly;

B2.4 demonstrate the correct use of various fastening techniques *(e.g., use of fasteners, sealants, bonding agents)*;

B2.5 demonstrate the safe and correct use of various fabrication and repair techniques *(e.g., cutting threads, heating, soldering, welding)*;

B2.6 perform basic engine repair, demonstrating understanding of the function and operation of engine components *(e.g., dismantle and reassemble a small engine safely and correctly, making necessary repairs in the process)*.

B3. Basic Service of Vehicle and/or Craft Systems and Components

By the end of this course, students will:

B3.1 locate and identify the major components of steering/control, suspension, brake, electrical, and body systems when performing basic service on a vehicle or craft;

B3.2 perform appropriate measurements related to system components *(e.g., tire pressure; chain, cable, and/or belt tension and wear; specific gravity of engine coolant; battery voltage)*, making any necessary adjustments to meet manufacturers' specifications;

B3.3 service steering/control, suspension, brake, electrical, and body system components *(e.g., lubricate body hinges [on doors, hood, trunk or hatch], balance tires, check brake fluid level, check vehicle height, charge a discharged battery*) safely and correctly.

B4. Care and Maintenance of Vehicles and/or Craft

By the end of this course, students will:

B4.1 perform exterior and interior surface care procedures *(e.g., detailing, washing and waxing, removal of debris from undercarriage)* safely and correctly;

B4.2 use proper procedures for winterizing and/or storing vehicles and/or craft *(e.g., test antifreeze, drain or stabilize fuel, take rust prevention measures)*.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of ways in which various aspects of the transportation industry affect the environment and ways in which harmful effects can be remedied or reduced;

C2. demonstrate an understanding of the relationship between various aspects of the transportation industry and society.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 research and report on ways in which the transportation industry affects the environment and on efforts being made to remedy or reduce harmful effects *(e.g., improved production methods, automotive parts recycling)*, including ways of disposing of waste products *(e.g., used oil, used batteries, used paint/thinners)*;

C1.2 describe the pros and cons of using environmentally friendly products *(e.g., biodegradable cleaners)* and procedures *(e.g., recycling of materials)* when servicing and/or maintaining vehicles and/or craft;

C1.3 describe the environmental impact of various modes of transportation *(e.g., tail-pipe emissions, noise pollution, water contamination and habitat degradation, bird and animal strikes)*.

C2. Technology and Society

By the end of this course, students will:

C2.1 research and report on the development of improved safety features in transportation technology *(e.g., airbags, anti-lock brakes)*;

C2.2 describe recent technological innovations *(e.g., related to performance, comfort, driveability, fuel economy, recycling of parts)* in vehicles and/or craft;

C2.3 explain the pros and cons of various means of transporting people/materials *(e.g., by road [bicycle, car, bus, truck], rail, air, water)* in terms of economy, safety, convenience, and so on.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and compliance with occupational health and safety regulations and standards in transportation technology;

D2. identify career opportunities in the transportation industry and the education and training required for them.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify and explain the importance of legislation and regulations related to procedures and operations used in transportation technology facilities *(e.g., Occupational Health and Safety Act [OHSA], Workplace Hazardous Materials Information System [WHMIS], Apprenticeship and Certification Act)*;

D1.2 demonstrate good housekeeping and safety practices in the work environment *(e.g., cleaning up spills and leaks, proper disposal of waste, keeping areas clean and clear of obstructions)*;

D1.3 use protective clothing and equipment *(e.g., eye and hearing protection, gloves, breathing apparatus)* as required to ensure their own and others' safety in the work environment.

D2. Career Opportunities

By the end of this course, students will:

D2.1 identify various sectors and occupational areas within the transportation industry *(e.g., **sectors:** air, sea, rail, road; **occupational areas:** manufacture of vehicles and/or craft, sales, service)*;

D2.2 identify a variety of career opportunities in the transportation industry *(e.g., apprenticeship/trade, parts retail, business ownership)* and describe the secondary school pathways (i.e., selection of courses, programs, and experiential learning opportunities) that would provide the best preparation for these careers;

D2.3 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the transportation industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D2.4 demonstrate an understanding of the Essential Skills that are important for success in the transportation industry, as identified in the Ontario Skills Passport *(e.g., finding information, measurement and calculation, problem solving)*;

D2.5 demonstrate an understanding of the work habits that are important for success in the transportation industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability)*;

D2.6 develop and/or select pieces of work and other materials that provide evidence of their skills and achievements in transportation technology, for inclusion in a portfolio *(e.g., work logs, skills checklist, sketches, photographs of projects)*.

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