CAR 701A

Career and Technical Education

Carpentry Technology

Introduction to Carpentry Technology

Curriculum Guide

Prince Edward Island
CANADA
Education, Early Learning and Culture

THIS PAGE IS INTENTIONALLY BLANK

Acknowledgements

The Prince Edward Island Department of Education, Early Learning and Culture (DEELC) of Prince Edward Island gratefully acknowledges the contributions of the following individuals in the development of the Prince Edward Island CTE Carpentry curriculum guides.

John Stephens	Career and Technical Education Innovation Leader
Peter Conaughton	Montague Regional High School
Rob Deacon	Colonel Gray High School
Gary Pyke	Kensington Intermediate and Senior High School
Trevor LeClair	Westisle Composite High School

Further acknowledgement to all career and technical education teachers across Prince Edward Island for their experience and knowledge. The conversations and feedback received throughout the process was critical to the completion of this document.

Prince Edward Island
Department of Education, Early Learning and Culture
250 Water Street, Suite 101
Summerside, Prince Edward Island, Canada, C1N 1B6
Tel: (902) 438-4130, Fax: (902) 438-4062
www.gov.pe.ca/eecd/

Implementation September 2018

Table of Contents

Table of Contents

Career and Technical Education

Curriculum Renewal

Renewal of curriculum begins with the common understanding that K-12 students must engage in learning that enables them to participate in a world of rapid and complex change. This dynamically evolving environment requires that students develop multiple literacies, increase depth of knowledge, and acquire a range of skills, attitudes, and abilities that foster creativity, innovation, and problem-solving skills.

Students must also develop a desire for personal and collective achievement and a willingness to collaborate for the well-being of themselves and others. It is essential that educators and administrators have an in-depth understanding of curricular expectations as part of a broader learning continuum.

Importance of Career and Technical Education

Career and Technical Education (CTE) provides relevance to learning and values the technical skills required to complete meaningful work as equally important to the academic skills required. This blend of thinking and doing is fundamental for CTE students to fully comprehend and demonstrate competency within CTE programming. The false dichotomy between hands-on and heads-on education is no longer relevant to modern education systems or modern economic systems. The current labour market demands that people have the ability to acquire skills, build proficiency, seek out critical knowledge, and adapt to an ever-changing landscape. To this end, students must be lifelong learners who commit to cultivating their knowledge and skills through a combination of experience and education.

High quality Career and Technical Education programs prepare students for success by incorporating rigorous academic and technical skills, essential workplace competencies, and a commitment to career education. Thinking and doing are not at odds; rather each is critical for the development of the other and the success of the learner.

Career and Technical Education curricula are designed to foster the development of all learners as technologically literate and capable citizens who possess the technical skills, strategic knowledge, and agility required in the development of innovative and responsible solutions to relevant technical problems and the career awareness required to transition to further education and work after secondary school.

Goals for Career and Technical Education

Students will develop

- the technical skills, confidence, and employability skills needed to gain employment within their area of interest along with the critical thinking and problem-solving skills required to sustain employment.
- the academic skills required to further their education and to embrace the ever-changing reality of technical work as active learners and innovators with an entrepreneurial spirit.
- the knowledge, skills, and attitudes that will enable the agility required to be actively engaged in the development and implementation of their own career plans.

> "If, instead of keeping a child at his books, I keep him busy in a workshop, his hands labor to his mind's advantage: while he regards himself only as a workman he is growing into a philosopher."
>
> Jean Jacques Rousseau
> Emile; or, Concerning Education
> p. 140, 1889

Course Descriptions

CAR701A - Introduction to Carpentry Technology (prerequisite for all 800 level CTE-Carpentry courses)

Introduction to Carpentry Technology is a project based course where students can expect to be engaged in carpentry projects that will develop their technical skills and challenge their critical thinking. CAR701A provides students the opportunity to develop technical skills with tools, equipment, and safe work practices within a carpentry setting. Students will be challenged to apply math concepts to solve technical problems and develop their literacy skills through design and drawing techniques. Students are expected to develop safe work habits, effective time/project management skills, and work effectively with others.

CAR801A - Framing Systems Level I (prerequisite courses for CAR801B - Framing Systems Level 2)

Framing Systems Level 1 is a project based course that introduces students to the fundamentals of framing within the Carpenter trade. Students will develop technical skills related to wall and floor framing and develop knowledge related to the effect forces have on, and how forces are transferred through, structures. Students are expected to develop safe work habits, effective time/project management skills, and work effectively with others.

CAR801B - Framing Systems Level II

Framing Systems Level 2 builds on the technical skills introduced in the Framing Skills Level 1 course. Students are expected to perform framing tasks with an increased proficiency and be able to articulate why particular techniques are used in different situations. Students will explore the building envelope and understand its implication related to framing and structures. Students are expected to continue to develop safe work habits, effective time/project management skills, and work effectively with others.

CAR801C - Construction Skills Level I (prerequisite courses for CAR801D - Construction Skills Level 2)

Carpentry Skills Level 1 is a project based course designed to introduce students to the wide range of carpentry and construction skills required when working within the carpentry trade. Students are expected to develop their technical skills related to the safe operation of common woodworking tools, technical drawings, and essential skills required within the Carpenter trade. Students are expected to develop safe work habits, effective time/project management skills, and work effectively with others.

CAR801D - Construction Skills Level II

Carpentry Skills Level 2 builds on the technical skills and knowledge introduced in the Level 1 course. Students are expected to perform construction and carpentry related projects/tasks with a high level of technical skills and be able to articulate why particular techniques are used in different situations. Students are expected to continue to develop safe work habits, effective time/project management skills, and work effectively with others.

CAR801E - Carpenter Apprenticeship Prep

Carpentry Apprenticeship is designed to provide students who are considering a future career related to the skilled trades, an understanding of the skills, and knowledge expected from an apprentice. The course will provide students an opportunity to explore the full range of topics expected from a level 1 Carpenter apprentice. Students will work on projects that support the continued development of their technical skills while becoming more articulate in their knowledge related to the carpentry trade.

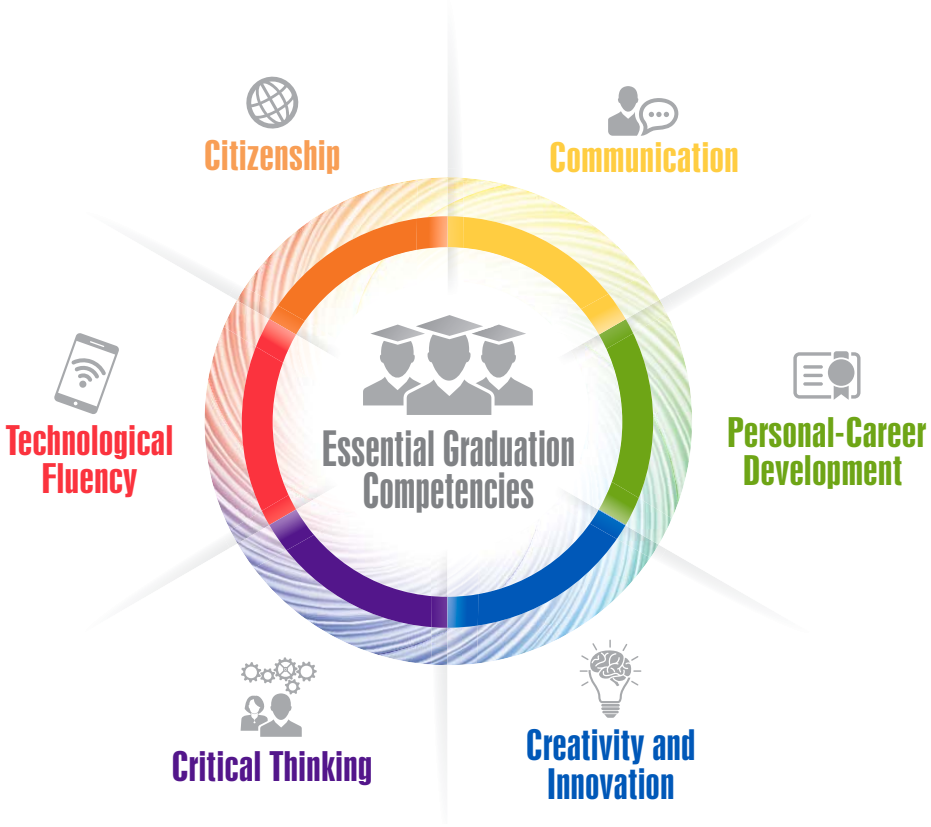
Students wanting to challenge the Level 1 Apprenticeship Exam for Carpenter will require this course + a minimum of 4 other CTE-Carpentry courses. The students average in all courses must be at or above 70% to qualify to challenge the Apprenticeship Exam.

Essential Graduation Competencies (EGCs)

EGC Overview

Curriculum is designed to articulate what students are expected to know and be able to do by the time they graduate from high school. The PEI Department of Education, Early Learning and Culture designs curriculum that is based on the Atlantic Canada Framework for Essential Graduation Competencies released by the Council of Atlantic Ministers of Education and Training (CAMET) in 2015.

Competencies articulate the interrelated sets of attitudes, skills, and knowledge—beyond foundational literacy and numeracy—that prepare learners to successfully participate in lifelong learning and life/work transitions. They are cross-curricular in nature and provide opportunities for interdisciplinary learning. Six competencies have been identified by CAMET: citizenship, communication, personal-career development, creativity and innovation, critical thinking, and technological fluency (Figure 1). Achievement of the essential graduation competencies (EGCs) will be addressed through the assessment and evaluation of curriculum outcomes developed for individual courses and programs.



EGC Definitions

Critical Thinking

Learners are expected to analyse and evaluate evidence, arguments, and ideas using various types of reasoning and systems thinking to inquire, make decisions, and solve problems. They reflect critically on thinking processes.

Technological Fluency

Learners are expected to use and apply technology to collaborate, communicate, create, innovate, learn, and solve problems. They use technology in a legal, safe, and ethically responsible manner.

Citizenship

Learners are expected to contribute to the quality and sustainability of their environment, communities, and society. They analyse cultural, economic, environmental, and social issues; make decisions and judgments; and solve problems and act as stewards in a local, national, and global context.

Communication

Learners are expected to express themselves and interpret effectively through a variety of media. They participate in critical dialogue, listen, read, view, and create for information, enrichment, and enjoyment.

Personal-Career Development

Learners are expected to become self-aware and self-directed individuals who set and pursue goals. They understand and appreciate how culture contributes to work and personal life roles. They make thoughtful decisions regarding health and wellness, and career pathways.

Creativity and Innovation

Learners are expected to demonstrate openness to new experiences; to engage in creative processes; to make unexpected connections; and to generate new and dynamic ideas, techniques, and products. They value aesthetic expression and appreciate the creative and innovative work of others.

Curriculum Design

General Curriculum Outcomes (GCOs)

General curriculum outcome statements articulate what students are expected to know and be able to do upon completion of study in technology education. These statements provide a concise description of the student as a technologically literate and capable citizen.

Technological Problem Solving

Students will be expected to design, develop, evaluate, and articulate technological solutions.

Technological problem solving incorporates a variety of strategies and processes, consumes resources, and results in products and services. Technological problem solving constitutes one of the most important ways in which students engage in technological activity.

Technological Systems

Students will be expected to operate and manage technological systems.

Technological systems are the primary organizational structure for products and services. Understanding the nature of systems and understanding how to employ, moderate, and re-structure systems are important components of technological literacy and capability.

History and Evolution of Technology

Students will be expected to demonstrate an understanding of the history and evolution of technology, and its social and cultural implications.

Technology, like many other areas of human endeavour, is often best understood in its historical context. Technology has had and continues to have profound effects on individuals, society, and the environment. Understanding the origins and effects of a particular technology provides a context for resolving today's problems and issues, and often leads to better solutions.

Technology and Careers

Students will be expected to demonstrate an understanding of current and evolving careers and the influence of technology on the nature of work.

All jobs, occupations, careers, and professions exist in technological environments. An understanding of the range of technologies in the workplace and their effects on the nature of work is critical to planning career and education paths.

Technological Responsibility

Students will be expected to demonstrate an understanding of the consequences of their technological choices.

The development of technology, and by extension its impact in the future, is entirely under human control. Individually and collectively, we share that responsibility. Accepting the responsibility and being empowered to take appropriate action require technological literacy and technological capability (knowledge, skills, and willingness).

Specific Curriculum Outcomes (SCOs)

Specific curriculum outcomes state the intended outcomes of instruction, and identify what students are expected to know and be able to do for a particular unit or course. SCOs provide the goals or targets of the prescribed education program referenced in 71(a) of the PEI Education Act. They provide a focus for instruction in terms of measurable or observable student performance and are the basis for the assessment of student achievement across the province. PEI specific curriculum outcomes are developed with consideration of Bloom's Taxonomy of Learning and essential graduation competencies.

Specific curriculum outcomes will begin with the phrase, "Students are expected to…".

Achievement Indicators (AIs)

Each specific curriculum outcome is described by a set of achievement indicators which help to support and define the depth and breadth of the corresponding SCO when taken as a set.

The set of achievement indicators provided for a specific curriculum outcome

- provides the intent (depth and breadth) of the outcome;
- tells the story, or creates a picture, of the outcome;
- defines the level and types of knowledge intended by the outcome;
- is not a mandatory checklist, prioritized list of instructional activities, or prescribed assessment items; and
- may include performance indicators.

The intent of AIs is for clarity and understanding, so that instructional design is aligned with the SCO. When teachers are planning for instruction, they must be aware of the set of indicators in order to fully understand the depth and breadth of the outcome. Teachers may substitute or add to the set of AIs as long as these additions maintain the integrity of the SCO. By constantly analysing and monitoring the needs of the students, teachers can determine which indicators are appropriate and relevant to prior knowledge, developmental stages, or the continuum of the scholastic year.

Lists of achievement indicators will begin with the phrase, "Students who have achieved this outcome should be able to…".

Sample of Curriculum Page

Targeted Level for Assessment of SCO

CTE

Introduction to Carpentry
CAR701A

Technical Skill Dimension					Safety Regulations		Knowledge Dimension			
Naturalization	Articulation	Precision	Manipulation	Imitation			Factual	Conceptual	Procedural	Metacognitive
Innovative		Complex		Simple	Cognitive Dimension					
					Recall	Remembering	1.1	1.2		
						Understanding		1.4		
			A.1		Procedural	Applying				
						Analysing		1.5	1.6	
					Critical Thinking	Evaluating				
						Creating				

SCO - Specific Curriculum Outcome

Unit A: Safety
Safety Regulations

A.1	Students are expected to … **demonstrate knowledge of regulatory requirements pertaining to safety in the carpentry trade.**

AIs - Set of Achievement Indicators for SCO

Achievement Indicators

Students who have achieved this outcome should be able to

A.1.1 define terminology associated with workplace hazards and safe work practices;

A.1.2 follow regulations and standards pertaining to workplace hazards and safe work practices;

A.1.3 examine the procedures used to maintain a safe work environment and to remediate potential dangers within the CTE-Carpentry facility;

A.1.4 discuss fire safety including the classes of fires, the fire triangle, and procedures and equipment related to fire safety; and

A.1.5 demonstrate the 3 rights of workers in their CTE-Carpentry coursework.

Elaboration

An elaboration provides a fuller description of the SCO and the instructional intent behind it. It sets the parameters of the SCO, gives background information where possible, and offers a broader context to help teachers gain a deeper understanding of the scope of the SCO. This may also include suggestions and/or supporting resources that may be helpful in teaching the related outcome. Teachers should vet material for any inappropriate sidebars, questionable information, or redirected links.

Performance Indicators

Performance indicators are located in the Elaboration section of the guide. They are intended to provide the teacher with a wide range of activities, ideas, and/or tasks that students may be engaged with as they progress towards mastery of an outcome. Performance indicators are not prescriptive and are not a checklist. The list of performance indicators is by no means an exhaustive list of possible tasks a student may engage in as they are working towards the outcome. Performance indicators help teachers to connect the work the students are engaged in to particular outcomes within a course.

Formative Assessment Guide

The formative assessment guide provides teachers with a general description of what the students are able to do within the context of each unit at each level of technical skill development. Teachers can use this tool as a foundation when developing customized rubrics, checklists, or observation methods. Teachers can also use the language in the formative assessment guide when providing descriptive feedback to students on how well they are progressing towards the learning outcome.

National Occupational Analysis

Each elaboration will also contain a reference to the National Occupational Analysis (NOA), for the trade. This is provided to highlight which Tasks, Required Knowledge, and Sub-tasks are aligned to a particular set of outcomes. Teachers are encouraged to familiarize themselves with the NOA for their trade. The NOA is designed to facilitate understanding of the occupation and the work performed by tradespersons.

Bloom's Taxonomy

In 1956, Bloom, et.al., published a framework for the purpose of classifying expectations for student learning as indicated by educational outcomes. This unidimensional framework of cognitive processes became known as Bloom's Taxonomy. David Krathwohl's 2002 revision of this taxonomy introduced a second dimension, the knowledge dimension, that classified the type of knowledge described by an outcome. To fully understand a specific curriculum outcome, it is important to understand how the learning is representative of both the cognitive process and knowledge dimensions.

Knowledge Process Dimension

The knowledge process dimension classifies four types of knowledge, ranging from concrete to abstract, learners may be expected to acquire or construct. The noun included in a specific curriculum outcome represents the knowledge process dimension.

	Explanation of Knowledge Level
Factual The basic elements students must know to be acquainted with a discipline or solve problems in it **KNOWING THAT**	• knowledge of terminology (e.g., technical vocabulary, name of equipment) • knowledge of specific details and elements (e.g., general shop safety procedures, operating procedures)
Conceptual The interrelationship among the basic elements within a larger structure that enables them to function together **KNOWING WHAT and WHY**	• knowledge of classifications and categories (e.g., types of tools, equipment, and materials) • knowledge of theories, models, and structures (e.g., building envelop, selecting materials)
Procedural How to do something, methods of inquiry, and criteria for using skills, algorithms, techniques, and methods **KNOWING HOW**	• knowledge of subject-specific-skills and algorithms (e.g., technical skills with tools, wall framing) • knowledge of subject-specific techniques and methods (e.g., safe operating procedures on stationary equipment) • knowledge of criteria for determining when to use appropriate procedures (e.g., work plans, procedures, bills of materials)
Metacognitive Knowledge of cognition in general as well as awareness and knowledge of one's own cognition **KNOWING HOW TO KNOW**	• strategic knowledge (i.e., knowledge of where to locate required information) • knowledge about cognitive tasks, including appropriate contextual and conditional knowledge (i.e., knowledge of the skills required to complete a task) • Self-knowledge (i.e., awareness of one's own knowledge and ability level)

Cognitive Process Dimension

The cognitive process dimension represents a continuum of increasing cognitive complexity, from lower order thinking skills to higher order thinking skills. The verb that begins a specific curriculum outcome represents the cognitive process dimension. The verbs listed under each cognitive process dimension represent the specific verbs used for SCOs or AIs within all six carpentry curricula. There is also a subject-specific definition of each cognitive process dimension that relates directly to carpentry technology.

Explanation of Cognitive Process Dimension	
Remembering	Retrieve, recall, and/or recognize specific information or knowledge from memory
	Students define terminology and locate equipment, tools, and safety requirements related to carpentry. Students follow protocols and procedures established within the carpentry facility.
Understanding	Construct meaning from different sources and types of information, and explain ideas and concepts
	Students can describe and/or explain the function and operation of tools, equipment, and procedures by reading, writing, and speaking. Students choose the correct procedure, tool, or resource to support their understanding of the knowledge and skill required to meet the outcome.
Applying	Implement or apply information to complete a task, carry out a procedure through executing or implementing knowledge
	Students execute a given task or work order when the procedure is provided. Students deepen their understanding of concepts by engaging their hands and practising their skills. Students communicate both orally and in writing, and are able to access information related to the carpentry tasks they are engaged in.
Analysing	Break information into component parts and determine how the parts relate or interrelate to one another or to an overall structure or purpose
	Students make the connection between the theory and the practice. Students begin to put together their understanding of building process, building science, design, and materials with their ability to complete carpentry tasks. Students will start to make connections between tasks and begin to transfer their knowledge to new situations. For example, when a student is demonstrating how to frame an interior wall partition they should be able to clearly demonstrate an understanding of both the theory and skills required to successfully complete the task.
Evaluating	Justify a decision or course of action, problem solve, or select materials and/or methods based on criteria and standards through checking and critiquing
	Students make decisions and select and adjust the working parameters independently to complete carpentry tasks. Students to begin to respond to challenges and perform tasks with a combination of both skill and precision. For example, when a student is building a rafter they should be able to interpret information and troubleshoot problems as they arise. Students should also be able to reflect on jobs and critique their own, and others performance.
Creating	Form a coherent functional whole by skillfully combining elements together and generating new knowledge to guide the execution of the work
	Students construct carpentry projects safely, efficiently, and with precision. They develop solutions to carpentry design, repair, and/or renovation problems safely, efficiently, and precisely. Students begin to take responsibility for their own knowledge and skill as a carpenter and approach their work in an independent manner and with a proficiency of skill.

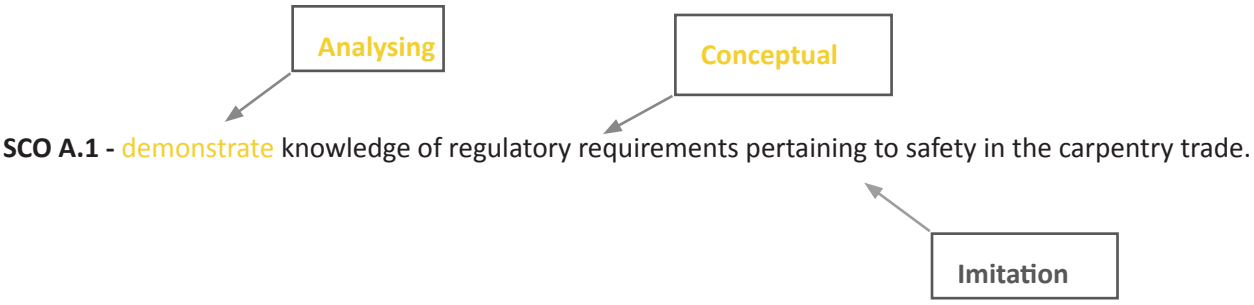
Technical Skill Dimension

The technical skill dimension, as defined by Dave's psychomotor taxonomy (1975), classifies five types of ways learners may be expected to demonstrate or carry out skilled tasks, procedures, or movements. This ranges from imitation, (where students mimic what they see modelled), through to naturalization, (where students perform tasks automatically and with high level of skill).

Explanation of Technical Skill Dimension	
Imitation	ability to copy or replicate the actions of others following observations
Manipulation	ability to repeat or reproduce actions to prescribed standard from memory or instructions
Precision	ability to perform actions with expertise and without interventions and the ability to demonstrate and explain actions to others
Articulation	ability to adapt existing psychomotor skills in a non-standard way, in different contexts, using alternative tools and instruments to satisfy need
Naturalization	ability to perform actions in an automatic, intuitive, or unconscious way appropriate to the context

SCO Structure

Examining the structure of a specific curriculum outcome is necessary to fully understand its intent prior to planning instruction and assessment. The Bloom's verb in the outcome relates to the expected level and type of thinking (cognitive process). A noun or phrase communicates the type of knowledge (i.e., factual, conceptual, procedural, or metacognitive) that is the focus of the outcome. The degree of technical skill is communicated through the remainder of the outcome and indicated on the Taxonomy Table.



Taxonomy Tables

Combining the three dimensions, (cognitive process dimension, knowledge process dimension, and technical skill dimension), into one taxonomy table helps teachers to visualize the overall expectations of a course. As teachers reflect deeply and collaborate with each other to identify the types of knowledge required by each outcome, they will be better able to plan what student achievement will look, sound, and feel like in the learning environment. This clear visualization of the desired results (i.e., evidence of achievement of outcomes) assists teachers in planning learning experiences that will lead to student achievement of the outcome at the targeted level.

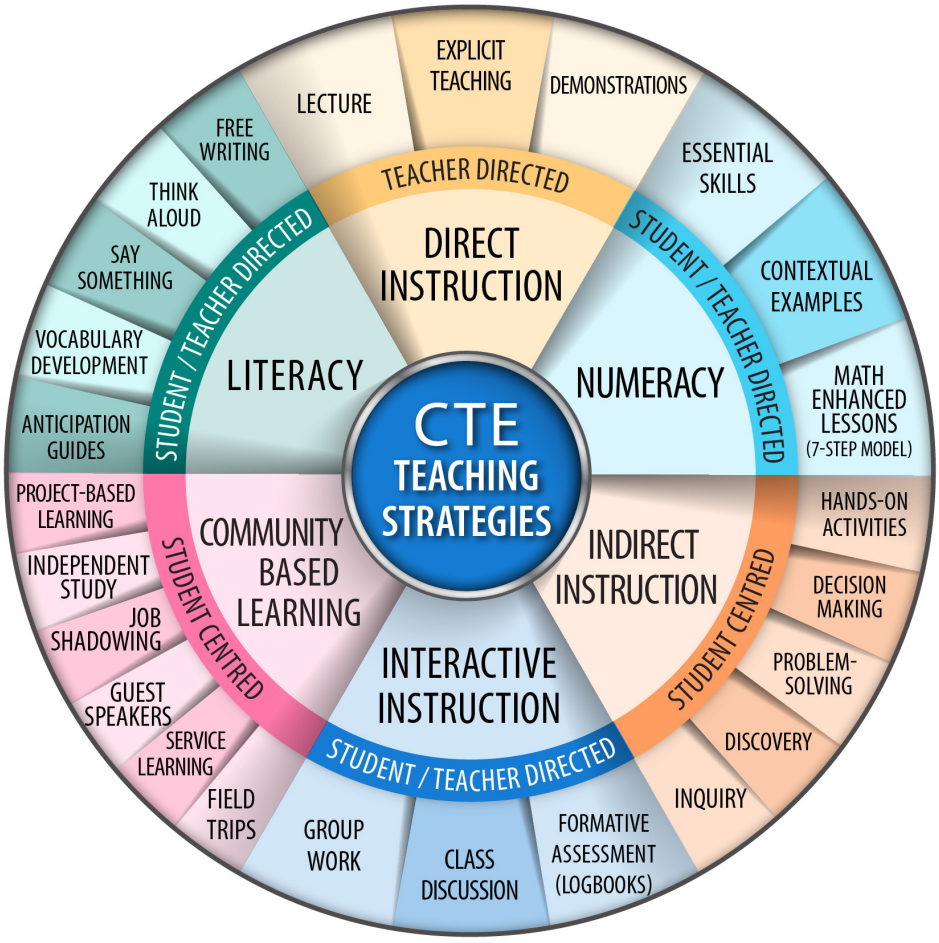
The taxonomy table for CAR 701A appears on page 25. Each outcome also has a taxonomy table that is specific to that outcome and the given achievement indicators. The table is located on the upper right-hand corner.

Curriculum Delivery

Instructional Strategies

Teaching is both a science and an art. There is a wealth of instructional strategies and methodologies described in the literature related to career and technical education that teachers have at their disposal when creating a learning environment that best suits the needs of their students.

Below is an instructional strategies wheel that is designed to identify a range of strategies that are effective when preparing lessons, assignments, and experiences for the career and technical education classroom. The list is not intended to be exhaustive, and CTE teachers are encouraged to continually read and engage in current research, pedagogy, and practice related to their field.



Literacy

Employing cross-curricular reading and writing strategies in the delivery of the curriculum will provide students with tools that will help them build knowledge and develop strategies to become more proficient in both their technical skills and their literacy skills. Integrating literacy into the CTE classroom is essential for students to develop strong connections between the practical skills and technical knowledge required.

Pre-Reading Strategies

Pre-reading strategies are used prior to assigning a reading and are designed to activate the students' prior knowledge on a subject, promote inquiry and discussion, provide clarity, and give the students reason to engage in the text. Examples include the following:

- FREE WRITING - This strategy provides students with a short amount of time to record what they already know or believe about the topic. Free writes should never be collected or evaluated. The only rule of the free write is that students write for the entire time allotted even if they run out of things to say.
- ANTICIPATION GUIDES - These guides consist of four or five statements about a topic that students are asked to either agree or disagree with prior to reading. The statements should be carefully crafted to raise the students' interest in the subject (so that all students do not respond in the same way), and be supported by the assigned reading. After reading, students should revisit and discuss their responses.

During-Reading Strategies

During-reading strategies are designed to promote active reading of the material. They provide students with specific tasks to complete or things to discover while reading the document. During-reading strategies can be used in small groups or as individual tasks.

- *THINK ALOUD* - Think Aloud is a very effective strategy to use when reading aloud to students. During the Think Aloud, it is important to model and reflect on how you yourself make meaning when reading challenging trade-related text, and how you relate the topic back to prior topics covered.
- *SAY SOMETHING* - Before assigning the Say Something, take time to model the strategy with a student or colleague and review the rules that will make for a successful Say Something. It is a good idea to post these rules so everyone can see them and be reminded of them during the activity.
    - *With your partner, decide who will say something first.*
    - *When you say something, make a prediction, ask a question, clarify something you had misunderstood, and/or make a connection.*
    - *If you cannot do one or more of the above things, then you need to re-read.*
- *RE-READING* - "Re-reading is probably the number one strategy independent readers use when something stumps them in a text. It's probably the last strategy dependent readers use" (Beers 2003, p.105). Before asking students to re-read a section of text, you must first set the activity up for success.
    - *Prove to students that re-reading is valuable to their learning. You can model this while doing a Think Aloud where you model your thinking as you interpret the text.*
    - *Provide the students with specific tasks to complete while they re-read a section.*
    - *Review the text as a group after everyone has re-read it.*

Post-Reading Strategies

Post-reading strategies are designed to provide students with opportunities to reflect on what they have read and make links to their learning.

- *LEARNING JOURNALS* - These journals provide a forum through which students can record and document their learning.
- *SUMMARIZING* - Summarizing is an effective strategy to use prior to having students complete an assigned task in the shop. This provides students with an opportunity to describe what they are going to do and how they plan to accomplish it. This may be done in written form or orally, depending on the given task.

Math in CTE

The National Council of Teachers of Mathematics states that wanting all students to learn math does not mean that all students can or should learn math in the same way.

The National Research Center for Career and Technical Education (NRCCTE) has developed the Math in CTE model that addresses and makes explicit the math concepts as they arise naturally from the CTE curriculum. Math is an essential component of CTE curriculum and is an essential tool required to perform the tasks of given occupations (NRCCTE 2006).

One of the challenges in teaching contextual math in CTE is that students are unable to transfer the math skills and knowledge to a new situation, as it is too embedded in the original context (NRCCTE 2006). The Math in CTE model addresses this challenge by bringing the math skill out of context and into the abstract, so that students may develop the understanding behind what they are learning, and then the model continues to provide opportunities for students to apply the knowledge in context.

By making explicit the math that is incorporated into the CTE context, students are able to make connections to their math classes and develop their transferable math skills.

Math in CTE 7-Step Model

Below is the 7-step Math in CTE model that will enable CTE teachers to identify the math skills covered in their lessons, develop a math-enhanced lesson, and assess the students' math abilities.

Introduce technical lesson.

- Explain the technical lesson.
- Identify the math embedded in the lesson.

Assess students' math awareness.

- Use a formative assessment.
- Assess whether students use the correct mathematical terms when discussing the lesson topic.
- Use a variety of questioning/discussion techniques to determine students' math awareness.

Work through math problems related to the technical lesson.

- Connect the technical vocabulary to the math vocabulary and gradually integrate the two, being sure to not abandon either set.

Work through related contextual examples.

- Use examples with varying levels of difficulty.
- Continue to bridge the gap between the technical concept and the math skills.
- Check for understanding.

Work through traditional math examples.

- Provide students with an opportunity to practise using a worksheet of basic math problems as they would appear on a test.
- Move from basic to advanced examples.
- Check for understanding.

Have students demonstrate understanding.

- Provide students with the opportunity to relate the math concept back to CTE context.
- Conclude the math lesson back in the context of the technical lesson.

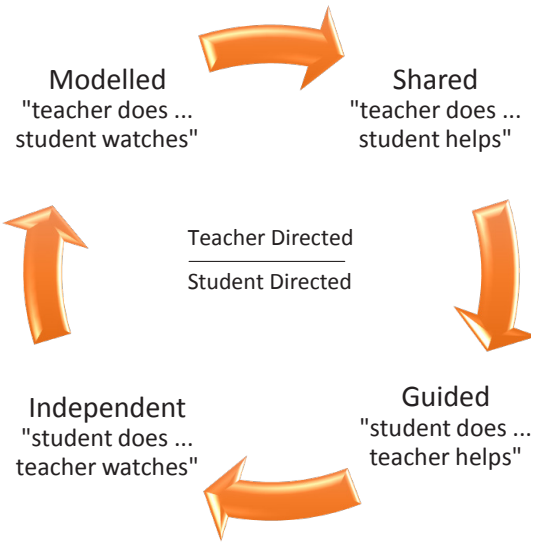
Assign a formal assessment.

- Include math problems in formal assessments of the technical lesson.

Gradual Release of Responsibility

Teachers must determine when students can work independently and when they require assistance. In the *gradual release of responsibility* approach, students move from a high level of teacher support to independent practice. The teacher models a concept or strategy and makes explicit the thinking he/she engages in when choosing and applying the strategy in a specific context. The teacher gradually releases the responsibility through a phase of shared and guided practice that leads the student to independence. If necessary, the teacher increases the level of support when students need further assistance. Gradual release is a useful strategy to employ. The graphic below provides a visual representation of this process.

Teachers may wish to begin the process at any point in the cycle. For example, teachers may provide a diagnostic assessment (independent stage) to establish what students know prior to teaching in order to determine which practices need to be modelled and which ones the students are able to perform independently.



Curricular Planning Using Understanding by Design

Understanding by Design (UbD) is often referred to as backward design. UbD is a curricular planning model developed by American educators Grant Wiggins and Jay McTighe. The main premise is that learning, and hence understanding, must be demonstrated through *transference*—the ability to apply what has been learned to a new situation or problem. In order to assess the level of learning, it is necessary to plan instruction as a backward experience of three stages beginning with the *end-in-mind* or the desired results, moving to the second stage of *evidence-of-learning* or assessment, and ending with the *learning plan* or the activities that will engage students and scaffold them toward the end result or *performance task*.

Basics of UbD

- helps transform specific curriculum outcomes (SCOs) into meaningful learning elements and assessments
- encourages teachers to become coaches and facilitators of meaningful learning rather than purveyors of superficial content
- reveals learning when students make sense of, and are able to transfer, learning to new and authentic situations
- requires ongoing review of instructional design to ensure effective practice and continuous improvement for achievement
- promotes a way of thinking about curricular planning in a broader sense, not a rigid program or prescriptive plan
- ensures deeper student understanding by making meaning from big ideas
- overcomes instructional errors associated with simplified textbook coverage and activity-oriented teaching (activity without a clear purpose)

Stage 1 Desired Results	Stage 2 Evidence	Stage 3 Learning Plan
The knowledge, skills, and attitudes that are articulated in specific curriculum outcomes (SCOs) are identified.	Performance tasks and criteria are determined. *Performance tasks* should be authentic tasks that are designed to simulate or replicate real-world performances and establish a realistic context with a genuine purpose, audience, and constraints. *Performance criteria* will provide the evidence of learning that is needed to assess the learning. Criteria can be weighted and include the following: • **Content** - aptness, adequacy, or accuracy of knowledge and skills used • **Process** - the means, processes, attitude, or approaches taken in the performance or in the preparation for performance • **Quality** - attention to detail, polish, and craftsmanship • **Impact** - Did the performance work? What was its effect, its result, its outcome - irrespective of effort, attitude, and approach?	In the final stage, the sequence of learning activities that will scaffold students toward the performance task and understanding are planned.

The Evaluative Process

Assessment and evaluation are integral components of the teaching and learning processes.

Effectively planned evaluation promotes learning, builds confidence, and develops students' understanding of themselves as learners. Effectively planned assessment and evaluation also improves and guides future instruction and learning.

Effective and authentic assessment involves

- designing performance tasks that align with specific curriculum outcomes;
- including students in determining how their learning will be demonstrated; and
- planning for the three phases of assessment (*for*, *as*, and *of* learning).

Through the entire evaluative process, the teacher reflects on the appropriateness of the assessment techniques used to evaluate student achievement of the SCOs. Such reflection assists the teacher in making decisions concerning adjustments to subsequent instruction, assessment, and evaluation.

Assessments need to be reflective of the cognitive process(es) and level(s) of knowledge and skill indicated by the outcome. An authentic assessment will collect data at the level for which it is designed.

Whether conducting assessment for learning or assessment of learning, a teacher must have sufficient proof of a student's learning. By using a process known as triangulation, teachers can obtain data of student learning from three different sources, (i.e., observations, conversations, and products), thereby ensuring sufficient data is collected in order to evaluate student learning. Observations and conservations are more informal forms of evidence that may be, for example, recorded as anecdotal notes. Products include tests, projects, or other tasks that enable students to demonstrate what they know and can do at the end of the learning process. By collecting data from multiple sources, teachers are able to verify the data they collect against each other, thus allowing them to gain an accurate portrayal of student progress.

Effective evaluation involves considering the totality of the assessment data and interpreting it to make informed judgments about student learning.

Assessment

Assessment is the act of gathering information on an ongoing basis in order to understand students' individual learning and needs. It is the journey of their learning.

Effective assessment improves the quality of learning and teaching. It helps students to become self-reflective and to feel in control of their own learning, and enables teachers to reflect on and adjust their instructional practices. When students are given opportunities to demonstrate what they know and what they can do with that knowledge, optimal performance can be realized.

Assessment has three interrelated purposes:

- assessment *for* learning to guide and inform instruction
- assessment *as* learning to involve students in self-assessment and setting goals for their own learning
- assessment *of* learning to determine student progress relative to curriculum outcomes

Even though each of the three purposes of assessment requires a different role and planning for teachers, the information gathered through any one purpose is beneficial and contributes to an overall picture of an individual student's achievement.

All assessment practices should respect the needs of diverse learners and should respect and appreciate learners' cultural diversity. Teachers should provide students with a variety of ways to demonstrate on an ongoing basis what they know and are able to do with many different types of assessment over time. Valuable information about students can be gained through intentional conversations, observations, processes, performance, and products. A balance among these sources ensures reliable and valid assessment of student learning.

Effective assessment strategies

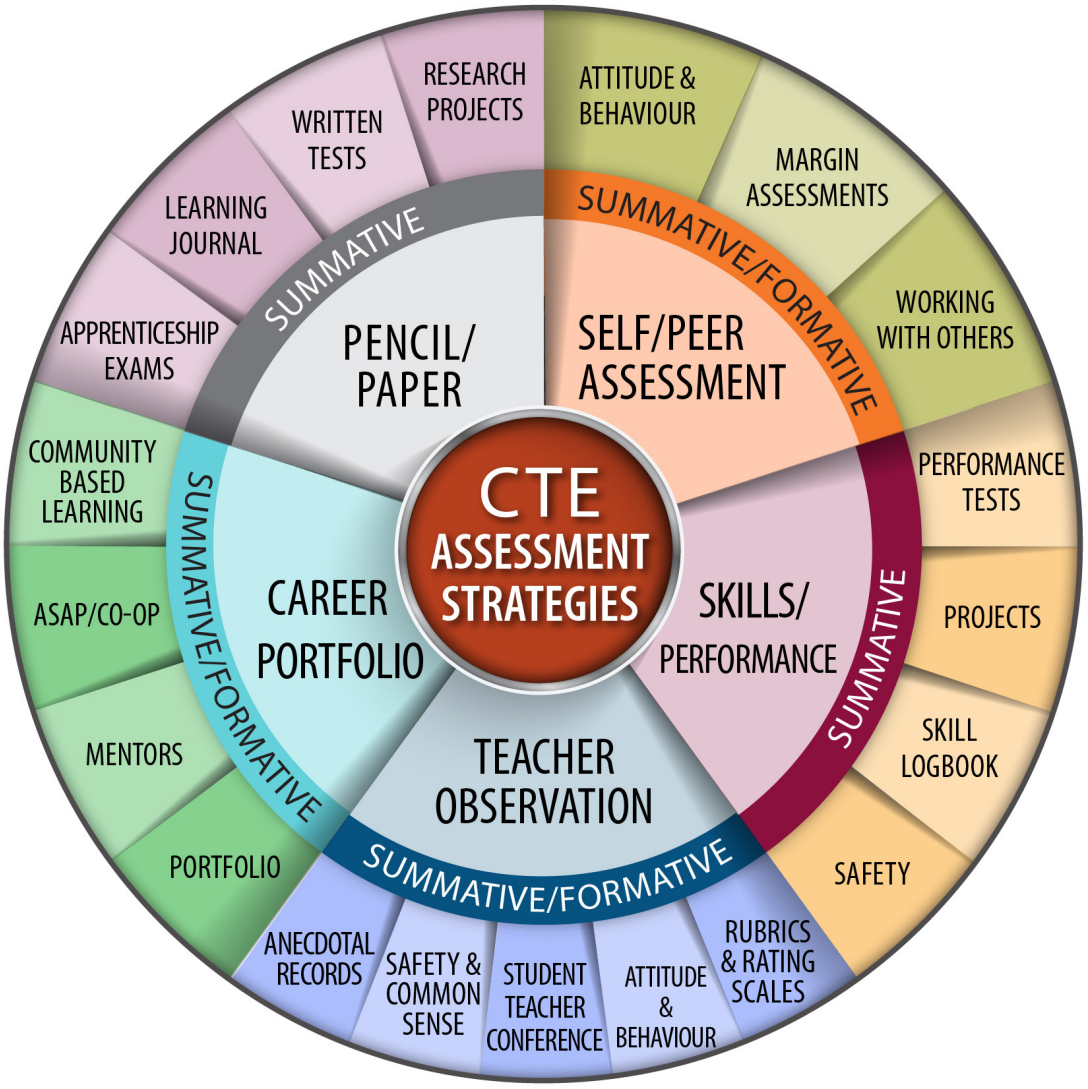
- are appropriate for the purposes of instruction, the needs and experiences of the students, and learning strategies used;
- assist teachers in selecting appropriate instruction and intervention strategies to promote the gradual release of responsibility;
- reflect where the students are in terms of learning and help to determine the levels and types of support or instruction that will follow;
- allow for relevant, descriptive, and supportive feedback that gives students clear directions for improvement, and engages students in metacognitive self-assessment and goal setting that can increase their success as learners;
- are explicit and communicated to students and parents so students know expectations and criteria to be used to determine the level of achievement;
- must be valid in that they measure what they intend to measure and reliable in that they consistently achieve the same results when used again, or similar results with a similar group of students;
- involve students in the co-construction, interpretation, and reporting of assessments by incorporating their interests, multiple intelligences, and learning styles;
- accommodate for the diverse learning needs of students; and
- are comprehensive and enable all students to have diverse and multiple opportunities to demonstrate their learning consistently and independently.

Students should know what they are expected to learn as designated by SCOs and the criteria that will be used to determine the quality of their achievement.

This information allows students to make informed choices about the most effective ways to demonstrate what they know and are able to do. It is important that students participate actively in assessment by co-creating criteria that can be used to make judgments about their own learning. Assessment must provide opportunities for students to reflect on their progress, evaluate their learning, and set goals for future learning. Students may benefit from examining various scoring criteria, rubrics, and student exemplars.

Student involvement in the assessment process can be achieved by

- incorporating students' interests into assessment tasks (e.g., allowing students to select and read texts that relate to their interests);
- providing opportunities for students to self-assess their learning; and
- co-creating assessment criteria with the student, working to describe how a specific skill or product is judged to be successful; and using student exemplars to illustrate a range of skill development (i.e., practise using the assessment criteria to guide their own work).



Evaluation

Evaluation is the culminating act of interpreting the balanced information gathered through relevant and authentic assessments for the purpose of making judgments.

Inherent in the idea of evaluating is "value." **Evaluation is based on the cumulative assessments of the SCOs. The SCOs should be clearly understood by learners before instruction, assessment, and evaluation takes place.** Evaluation is informed by a quality, authentic formative and summative assessment process.

During evaluation, the teacher:

- interprets all assessment information and makes judgments about student progress;
- reports on student progress; and
- makes informed decisions about student learning programs based on the judgments or evaluations.

STEAM Pedagogy

The acronym STEAM represents Science, Technology, Engineering, Art, and Math. STEAM education is a pedagogical approach which provides students the opportunity to integrate learning associated with these five disciplines while solving meaningful problems.

The original acronym, STEM was introduced in the 1990s by the National Science Foundation. The 'A' was added to STEM in recognition that creative thinking normally associated with art is as necessary as analytical thinking when solving problems in science, engineering, and technology. The ability to think mathematically is also an integral aspect of these three fields.

Problem-solving is an iterative, multi-layered and multi-stepped process that requires flexible thinking patterns (Figure 12). The analytical thinking component involves selecting, gathering, sorting, comparing, and contrasting information. Analytical thinking is convergent thinking which helps to identify and narrow possible solutions. Creative thinking is required to solve broad, open-ended problems that do not have a readily apparent solution and are not single-outcome specific. Creative processes involves divergent thinking or out-of-the-box thinking. A creative thinker may consider solutions that are based on intuition and emotion rather than logic. Creative solutions can also arise from observation, inspiration, and serendipity. STEAM activities are designed to encourage the flexibility to move back and forth between these two cognitive processes. They also support the development of other habits of mind necessary for STEAM such as persistence and resilience.

Selected Habits of Mind and Skills Encouraged by STEAM

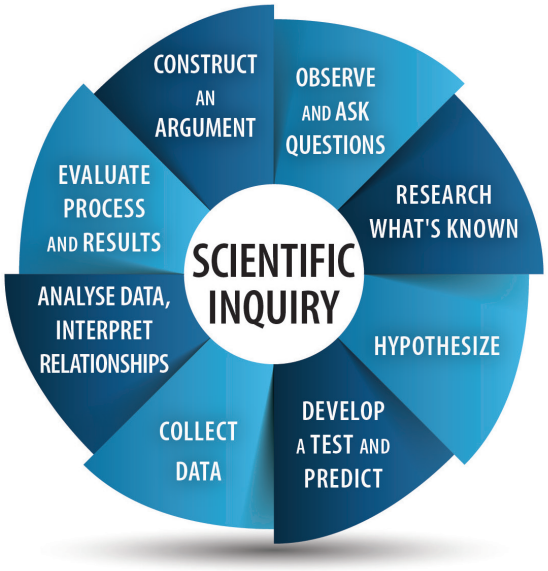
- creativity
- innovation
- persistence
- resilience
- flexibility
- collaboration
- communication
- critical thinking
- analytical thinking
- manipulative skills
- digital fluency

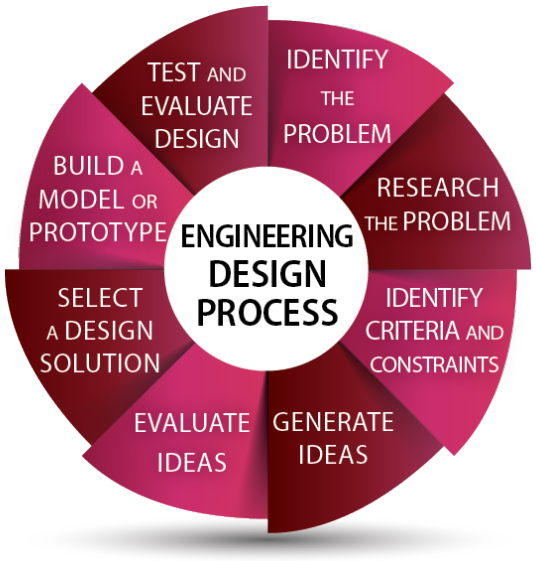
All five disciplines do not have to be targeted at the same time during a STEAM activity. To obtain the benefit of STEAM-based instruction, the problem presented should not have a readily apparent solution or be single outcome specific. The problem should be open-ended and designed in a way that the learner has more than one possible path to the solution. Productive struggle and reflection should be encouraged.

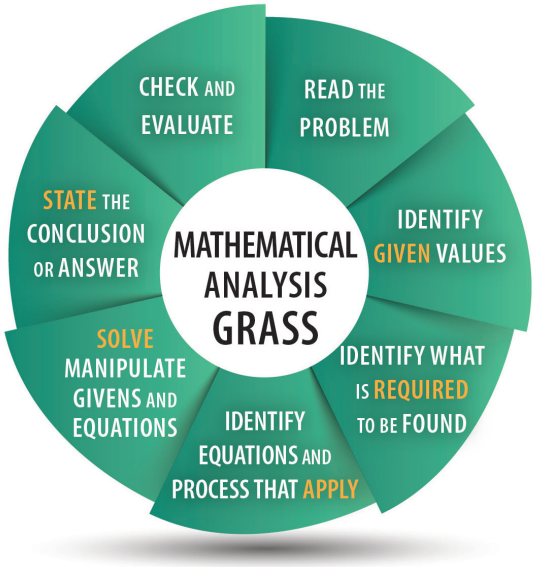
Problem-Solving Component	**S**	**T**	**E**	**A**	**M**
	Science	Technology	Engineering	Art	Mathematics
Nature of Problem	Extending our understanding of the natural world	Developing ways to extend human capacity	Addressing a human need or concern	Expressing and interpreting human perception	Discovering mathematical relationships
Name of Process	Scientific Inquiry	Technology Design	Engineering Design	Creative Process	Mathematical Analysis
Initial Question	What causes...?	How can I...?	How can I make...?	Imagine if...	What is the relationship...?
Solutions and Products	Communications of new knowledge	Digital products, digital processes	Structures, equipment, machines, processes	Aesthetic expression, products, processes	Numerical solutions, equations

Steam Processes

STEAM problem-solving processes (i.e., scientific inquiry, technology and engineering design, the creative process, and mathematical analysis) differ in the nature of the question and the solution or product. However, all are based on the generic problem-solving process. All are iterative processes that involve reflection, evaluation, and feedback throughout. All require analytical thinking and creative thinking. The figures below compare the problem-solving processes for science, engineering, art, and math.







Career & Technical Education

Carpentry Technology

Introduction to Carpentry

Course Description

Introduction to Carpentry Technology is a project based course where students can expect to be engaged in carpentry projects that will develop their technical skills and challenge their critical thinking. CAR701A provides students the opportunity to develop technical skills with tools, equipment, and safe work practices within a carpentry setting. Students will be challenged to apply math concepts to solve technical problems and develop their literacy skills through design and drawing techniques. Students are expected to develop safe work habits, effective time/project management skills, and work effectively with others.

Taxonomy Table

Technical Skill Dimension					CAR 701A		Knowledge Dimension			
Naturalization	Articulation	Precision	Manipulation	Imitation			Factual	Conceptual	Procedural	Metacognitive
Innovative		Complex		Simple	Cognitive Dimension					
					Recall	Remembering				
						Understanding				
		A.3, B.1, D.1		A.1, A.2, B.2, B.3, C.1, C.2, C.3	Procedural	Applying		B.2, B.3	A.2, C.1, C.2, C.3	
						Analysing		A.1, B.1	A.3, D.1	
		D.2		B.4	Critical Thinking	Evaluating				
						Creating			D.2	B.4

Technical Skill Dimension					Safety Regulations		Knowledge Dimension			
Naturalization / Articulation		Precision	Manipulation	Imitation			Factual	Conceptual	Procedural	Metacognitive
Innovative		Complex		Simple	Cognitive Dimension					
					Recall	Remembering	1.1	1.2		
						Understanding		1.4		
			A.1		Procedural	Applying				
						Analysing		1.5	1.6	
					Critical Thinking	Evaluating				
						Creating				

Unit A: Safety
Safety Regulations

A.1	Students are expected to… **demonstrate knowledge of regulatory requirements pertaining to safety in the carpentry trade.**

Achievement Indicators

Students who have achieved this outcome should be able to…

A.1.1 define terminology associated with workplace hazards and safe work practices;

A.1.2 follow regulations and standards pertaining to workplace hazards and safe work practices;

A.1.3 examine the procedures used to maintain a safe work environment and to remediate potential dangers within the CTE-Carpentry facility;

A.1.4 discuss fire safety including the classes of fires, the fire triangle, and procedures and equipment related to fire safety; and

A.1.5 demonstrate the 3 rights of workers in their CTE-Carpentry coursework.

Technical Skill Dimension					Carpentry Facility Safety		Knowledge Dimension			
Naturalization	Articulation	Precision	Manipulation	Imitation			Factual	Conceptual	Procedural	Metacognitive
Innovative		Complex		Simple	Cognitive Dimension					
					Recall	Remembering			2.4, 2.5, 2.8, 2.9	
						Understanding		2.1	2.2, 2.3	
				A.2	Procedural	Applying			2.6, 2.7	
						Analysing				
					Critical Thinking	Evaluating				
						Creating				

Unit A: Safety
Carpentry Facility Safety

A.2	Students are expected to… **apply safe work practices and the proper use of safety equipment related to carpentry.**

Achievement Indicators
Students who have achieved this outcome should be able to…

A.2.1 identify safety hazards related the carpentry trade as either personal hazards, workplace hazards, and/or enviromental hazards;

A.2.2 explain safe work practices within the CTE-Carpentry facility (personal, workplace, environmental);

A.2.3 describe equipment used to address safety hazards (personal, workplace, environmental);

A.2.4 follow the procedures used to lock out and tag out equipment;

A.2.5 follow procedures used to store, transport, and dispose of materials;

A.2.6 apply procedures used to maintain a safe work environment;

A.2.7 report potential dangers related to workplace hazards;

A.2.8 follow safety procedures for the use of various types of ladders; and

A.2.9 follow safety procedures the use of various types of scaffolds.

Technical Skill Dimension					Personal Protective Equipment		Knowledge Dimension			
Naturalization / Articulation		Precision / Manipulation		Imitation			Factual	Conceptual	Procedural	Metacognitive
Innovative		Complex		Simple	Cognitive Dimension					
					Recall	Remembering				
						Understanding			3.1	
		A.3			Procedural	Applying			3.2, 3.4	
						Analysing			3.3	
					Critical Thinking	Evaluating				
						Creating				

Unit A: Safety

Personal Protective Equipment

A.3	Students are expected to… **demonstrate the proper use of personal protective equipment (PPE).**

Achievement Indicators

Students who have achieved this outcome should be able to…

A.3.1 explain the proper use of PPE required for particular tasks and/or applications;

A.3.2 demonstrate the proper use and selection of PPE at all times when working in the CTE facility;

A.3.3 report defects or damage to PPE; and

A.3.4 apply procedures for the proper maintenance and storage of PPE.

Elaboration

The outcomes A.1, A.2, and A.3 are integrated outcomes and therefore cannot be taught or learned in isolation from the ongoing work within the context of the CTE-Carpentry program.

The intention of the outcomes in Unit A is to raise the awareness and skills connected to the importance of taking necessary measures to ensure personal safety and the safety of others when working on carpentry tasks.

The assessment of these outcomes should be ongoing throughout the course and students should be given frequent descriptive feedback related to their safe work practices, the application of general safety procedures, and on their selection and use of Personal Protective Equipment (PPE) within the carpentry course.

Safe working procedures and conditions, accident prevention, and the preservation of health are of primary importance when teaching and learning in the CTE-Carpentry facility. These responsibilities are shared and require the joint efforts of teachers, students, and school leaders.

CTE Teachers have a responsibility to model, instruct, and assess students ability to work and learn in a safe and appropriate manner within the CTE-Carpentry facility. This includes, but not limited to

- modelling safe work practices for students;
- ensuring all students are present for all safety lessons/demonstrations required within the course; and
- providing students the opportunity to demonstrate their skills in a controlled environment prior to working independently. An example of an effective pedagogy is the Gradual Release of Responsibility model which includes: a) Focus Lessons/Guided Demonstrations, b) Collaborative Learning/Guided Practice, and c) Independent Work with Frequent Feedback.

It is important to note that the gradual release of responsibility model is not linear. Students move back and forth between each of the components based on the feedback from teachers and peers as they develop safe work habits and progress towards a mastery of skills.

CTE Teachers are expected to maintain accurate records related to safety within the CTE-Facility which include, but not limited to

- attendance records;
- assessments (formative and summative); and
- accident/incident report forms.

Formative Assessment Guide

As students begin to take responsibility for both their own and others' safety, they become more responsible and take a more proactive approach to safety. Below is a sample of a formative assessment rubric that can be used by teachers to develop customized rubrics, observation charts, or other formative assessment tools. Teachers can also use this language when providing descriptive feedback to students on how well they are progressing towards the learning outcomes defined by this unit.

Naturalization/Articulation	Precision	Manipulation	Imitation	
Innovative (end of 6th course)	**Complex (end of 3rd course)**		**Simple (end of 1st course)**	
Students can discuss the importance of safety within the workplace and relate experiences of others to their own experiences as it relates to safety.	Students can identify potential safety hazards and follow the steps to avoid them.		Students can locate key areas in the facility related to safety, such as the location of personal protective equipment (PPE), fire exits, and first aid kits.	**Recall**
Students demonstrate leadership qualities during routine inspections and routine maintenance; lead demonstrations of safety procedures, and assumes responsibility for their personal safety and the safety of others.	Students can use PPE appropriately; apply the rights and responsibilities of workers; implement the safety code of conduct; apply routine maintenance procedures.		Students can explain the procedures to follow in the event of a safety incident; understand the safety code of conduct and participate in routine maintenance of the facility.	**Procedural**
Students can examine potential safety hazards and design possible solutions; articulate and defend the Rights of Workers.	Students can inspect the condition of PPE; compare the Rights of Workers to students rights within the technology facility.		Students can select the appropriate PPE for a given task and understand the Rights of Workers.	**Critical Thinking**

National Occupational Analysis - Carpenter 2013

Task 2 - Performs safety related activities.

Required Knowledge	Sub Tasks
K 1 - types of PPE and safety equipment such as hard hats, fall protection, hand protection, eye protection, respiratory protection, and hearing protection K 2 - PPE and safety equipment operation K 3 - training requirements for PPE and safety equipment K 4 - jurisdictional health and safety acts and regulations K 5 - Canadian Standards Association (CSA) Standards K 6 - safety manuals and procedures K 7 - safety training requirements such as for confined space entry, working near high voltage and on elevated work platforms, and equipment operation K 8 - lock-out and tag-out procedures K 9 - location of first aid stations	A-2.01 - Uses personal protective equipment (PPE) and safety equipment. A-2.02 - Maintains safe work environment.

Technical Skill Dimension					Employability Skills		Knowledge Dimension			
Naturalization / Articulation		Precision / Manipulation		Imitation			Factual	Conceptual	Procedural	Metacognitive
Innovative		Complex		Simple	Cognitive Dimension					
					Recall	Remembering				
						Understanding				
		B.1			Procedural	Applying				
						Analysing		1.1, 1.2, 1.3, 1.4		
					Critical Thinking	Evaluating				
						Creating				

Unit B: Career Development
Employability Skills

B.1	Students are expected to… **demonstrate essential workplace employability skills.**

Achievement Indicators
Students who have achieved this outcome should be able to…

B.1.1 demonstrate a positive attitude towards their work, instructors, and classmates;

B.1.2 demonstrate a productive work ethic;

B.1.3 demonstrate effective time management skills; and

B.1.4 demonstrate employability skills and essential skills related to the carpenter trade when working within the CTE-Carpentry program.

Technical Skill Dimension					Numeracy		Knowledge Dimension			
Naturalization / Articulation		Precision	Manipulation	Imitation			Factual	Conceptual	Procedural	Metacognitive
Innovative		Complex		Simple	Cognitive Dimension					
					Recall	Remembering				
						Understanding		2.5		
				B.2	Procedural	Applying		2.1, 2.2, 2.3, 2.4, 2.8,	2.6, 2.7, 2.9	
						Analysing				
					Critical Thinking	Evaluating				
						Creating				

Unit B: Career Development
Numeracy

B.2	Students are expected to… **apply essential numeracy skills to solve carpentry problems.**

Achievement Indicators
Students who have achieved this outcome should be able to…

B.2.1 apply mathematical skills involving fractions to trade related problems;

B.2.2 apply mathematical skills involving decimals to trade related problems;

B.2.3 apply mathematical skills involving geometry to trade related problems;

B.2.4 apply mathematical skills involving estimation to trade related problems;

B.2.5 describe the use of drawing instruments (e.g., pencils, t-square, set squares, scale rules, protractor, compass/dividers, templates);

B.2.6 practise producing shapes, angles, and drawing to scale with the basic drafting instruments;

B.2.7 practise drawing horizontal, vertical, and angular lines;

B.2.8 read a metric scale rule and an imperial scale rule; and

B.2.9 practise marking a 90˚ angle.

Technical Skill Dimension					Literacy		Knowledge Dimension			
Naturalization / Articulation		Precision	Manipulation	Imitation			Factual	Conceptual	Procedural	Metacognitive
Innovative		Complex		Simple	Cognitive Dimension					
					Recall	Remembering				
						Understanding				
				B.3	Procedural	Applying		3.1, 3.2, 3.3, 3.5, 3.7	3.4, 3.6	
						Analysing				
					Critical Thinking	Evaluating				
						Creating				

Unit B: Career Development
Literacy

B.3	Students are expected to… **apply essential literacy skills to work effectively within the trade.**

Achievement Indicators
Students who have achieved this outcome should be able to…

B.3.1 read plans and specifications to construct carpentry projects;

B.3.2 read equipment and safety manuals describing safe operating procedures;

B.3.3 read detailed carpentry procedures;

B.3.4 apply proper work procedures and safety guidelines;

B.3.5 read blueprints and working diagrams to advise on materials and procedures;

B.3.6 apply accurate record keeping procedures to track work process and progress; and

B.3.7 communicate ideas using technical language and terminology common to the carpenter trade.

Technical Skill Dimension					Career Portfolio		Knowledge Dimension			
Naturalization	Articulation	Precision	Manipulation	Imitation			Factual	Conceptual	Procedural	Metacognitive
Innovative		Complex		Simple	Cognitive Dimension					
					Recall	Remembering				
						Understanding				
					Procedural	Applying				
						Analysing		4.2, 4.3		
				B.4	Critical Thinking	Evaluating				4.1
						Creating				4.4

Unit B: Career Development
Career Portfolio

B.4	Students are expected to… **create a personal CTE Portfolio to document and record employability and technical skills.**

Achievement Indicators
Students who have achieved this outcome should be able to…

B.4.1 reflect on individual progress related to specific technical skills and knowledge as well as transferable skills acquired within the CTE-Carpentry course;

B.4.2 research opportunities available and related careers connected to the carpentry trade using relevant trade documents (NOA, NOC, Red Seal website, IPG);

B.4.3 research secondary and post-secondary opportunities to further engage in trade-related occupations; and

C.1.4 create a portfolio to document specific technical skills, knowledge, and transferable skills to support their career development and personal goals.

Elaboration

The outcomes in Unit B - Career Development are integrated outcomes and therefore cannot be taught or learned in isolation from the ongoing work within the carpentry facility. These outcomes require the students to actively participate in all projects, tasks, and learning opportunities related to the course.

Students should be assessed on these outcomes on an ongoing basis and should be given timely formative feedback to enable them to deepen their knowledge and develop their skills related to employability skills, numeracy skills, literacy skills, and career development.

The factual knowledge required in Unit B should be presented to the students using relevant, trade related examples and supported by the Employability Skills 2000+ (Conference Board of Canada), the Essential Skills (HRSDC), and the National Occupational Analysis - Carpentry (Red Seal Program).

Essential Skills in CTE

Personal Management and Teamwork Skills as defined by the Conference Board of Canada 2000+ Employability Skills.

Demonstrate Positive Attitudes and Behaviours

- feel good about yourself and be confident
- deal with people, problems, and situations with honesty, integrity, and personal ethics
- recognize your own and other people's good efforts
- take care of your personal health
- show interest, initiative, and effort

Be Responsible

- set goals and priorities, balancing work and personal life
- plan and manage time, money, and other resources to achieve goals
- assess, weigh, and manage risk
- be accountable for your actions and the actions of your group
- be socially responsible and contribute to your community

Be Adaptable

- work independently or as part of a team
- carry out multiple tasks or projects
- be innovative and resourceful; identify and suggest alternative ways to achieve goals and get the job done
- be open and respond constructively to change
- learn from your mistakes and accept feedback
- cope with uncertainty

Learn Continuously

- be willing to continuously learn and grow
- assess personal strengths and areas for development
- set your own learning goals
- identify and access learning sources and opportunities
- plan for and achieve your learning goals

Work with Others

- understand and work within the dynamics of a group
- ensure that a team's purpose and objectives are clear
- be flexible; respect, and be open to and supportive of the thoughts, opinions, and contributions of others in a group
- recognize and respect people's diversity, individual differences, and perspectives
- accept and provide feedback in a constructive and considerate manner
- contribute to a team by sharing information and expertise
- lead or support when appropriate, motivating a group for high performance
- understand the role of conflict in a group to reach solutions
- manage and resolve conflict when appropriate

Participate in Projects and Tasks

- plan, design, or carry out a project or task from start to finish with well-defined objectives and outcomes
- develop a plan, seek feedback, test, revise, and implement
- work to agreed-upon quality standards and specifications
- select and use appropriate tools and technology for a task or project
- adapt to changing requirements and information continuously to monitor the success of a project or task and identify ways to improve

Numeracy in CTE

Success in any trade or technology requires that students develop strong number sense and proficiency when performing carpentry tasks requiring mathematical skills. Number sense develops when students connect numbers to real-life experiences, thereby allowing them to apply mathematical operations in a concrete manner to solve real contextual problems.

The intention of Numeracy in CTE is not to directly teach the math skills defined by the achievement indicators; rather it is to intentionally challenge the students with real-world technical problems that will require them to use/develop their math skills.

To support teachers in the instruction and assessment of contextual mathematics, there is a 7-step lesson planning progress call Math-in-CTE that was developed by the National Research Centre for Career and Technical Education.

Literacy in CTE

Success in any trade or technical field requires that students develop strong literacy and communication skills. Students need to be able to communicate effectively and appropriately within all aspects of the carpentry trade in verbal, non-verbal, electronic, and written forms.

Literacy skills as defined by the Conference Board of Canada 2000+ Employability Skills.

Communicate

- read and understand information presented in a variety of forms (e.g., words, graphs, charts, diagrams)
- write and speak so others pay attention and understand
- listen and ask questions to understand and appreciate the points of view of others
- share information using a range of information and communication technologies (e.g., voice mail, e-mail, computers)
- use relevant scientific, technological, and mathematical knowledge and skills to explain or clarify ideas

Manage Information

- locate, gather, and organize information using appropriate technology and information systems
- access, analyse, and apply knowledge and skills from various disciplines (e.g., the arts, languages, science, technology, mathematics, social sciences, and the humanities)

CTE Career Portfolio

The purpose of the CTE Career Portfolio is for students to begin to discover the purpose and relevance of their learning in the CTE environment and how it connects to their current and future goals. CTE programs offer students the opportunity to gain valuable experience working on real and relevant projects all the while building technical skills within the discipline. These experience and technical skills can open a wide range of doors for students as they progress through high school, enter the labour market, and consider their post-secondary options. It is critical that CTE teachers engage students in meaningful conversations related to the CTE-Portfolio so students are able to articulate their experience and value their learning with the CTE program.

Formative Assessment Guide

Naturalization/Articulation	Precision	Manipulation	Imitation	
Innovative (end of 6th course)	**Complex (end of 3rd course)**		**Simple (end of 1st course)**	
Students communicate and discuss solutions to carpentry problems using both existing and emerging terminology within trade; strategically apply mathematical reasoning and number sense to solve technical problems.	Students use carpentry terminology to help solve problems; use the common carpentry tool to solve basic mathematical problems.		Students can communicate with others using common trade language and perform basic mathematical calculations.	**Recall**
Students demonstrate a work ethic that is expected of an entry level Carpenter Apprentice; adjust work schedules and lead work crews to ensure work is completed.	Students demonstrate a work ethic that shows a commitment to both the task and the others within the group; determine work schedules and timelines to ensure work is completed.		Students can follow workplace protocols such as arriving on time, remaining on-task to complete assigned work, and working effectively as member of a group.	**Procedural**
Students have a clear understanding of their next steps and leverage the CTE-Portfolio to help them activate their plan for either a transition to the labour market or to post-secondary training (Apprenticeship, College, University).	Students use the evidence in their CTE Portfolio to determine their next steps; they continue to collect evidence and deepen their understanding of career and post-secondary options available through the Carpentry program.		Students can collect and record relevant information to begin to build their CTE Portfolio.	**Critical Thinking**

Essential Skills for Carpenter

The information below is from the Essential Skills for Carpenter Fact Sheet. Use this fact sheet to learn how essential skills are used on the job, find out the skills you need to succeed in your trade, and help prepare yourself for your career.

Reading	**Numeracy**
• Read project specifications to understand what is required for a project. • Read specification books and notes on blueprints. • Read and understand first aid and safety reports. • Read and understand safety inspection manuals. • Read and interpret building codes, regulations and standards to comply with regulations. • Read installation manuals. • Read industry trade magazines to learn about technological advancements, such as new construction materials and methods.	• Estimate how long it will take to complete a job. • Calculate the quantity of materials needed for a job, such as the volume of concrete required for footings. • Convert between metric and imperial measurement systems. • Verify bills when purchasing tools, accounting for discounts and taxes. • Analyse survey data for excavations to draw conclusions about safety. • Take precise measurements using survey instruments. • Make scale drawings. • Calculate stringers, treads, and risers to build stairs. • Calculate a rafter line length using the measurements of rise and run.
Document Use	**Writing**
• Interpret labels such as the Workplace Hazardous Materials Information System (WHMIS) to follow safety guidelines. • Interpret signs for information about directions, cautions, and safety procedures. • Complete time cards to record work hours. • Interpret shop drawings and specifications for the sizes, locations, and types of materials required for a job. • Prepare lists of materials. • Make sketches of drawings or plans to use on job sites. • Refer to load charts to determine load bearing capacities when operating material handling equipment. • Interpret blueprints to verify measurements, determine the integrity of plans, and to report mistakes.	• Record information on work activities such as problems encountered and resolved and hours of work. • Write purchase orders for materials. • Write safety and accident reports. • Write change orders to recommend blueprint modifications. • Write reports for project meetings.

Working with Others	Computer Use
• Work frequently in pairs. • Lead construction teams while working with other tradespersons, forepersons, suppliers, and engineers. • Work as a team to promote safety.	• Use computer-controlled equipment, such as total stations, smart levels, and workplace alarm systems. • Continuous learning. • Keep up-to-date with codes, regulations, standards, and materials. • Keep up-to-date with emerging skills and methods from technological advancements.
Thinking	**Oral Communication**
• Adapt routine tasks when working in a confined space. • Consult other carpenters to share knowledge and experience. • Refer to blueprints and specifications to obtain detailed project information. • Analyse blueprints and actual measurements to identify errors. • Make decisions to use materials efficiently. • Make decisions about constructing and building structures, such as decks, stairs, and platforms.	• Talk to suppliers to order materials or compare prices. • Interact with other carpenters to discuss work schedules, safety concerns, and to share ideas. • Communicate with a foreperson to report on work progress and troubleshoot problems. • Talk to manufacturer representatives to discuss problems with equipment and materials. • Interact with owner(s) to discuss new ideas and potential changes.

Technical Skill Dimension					Hand Tools		Knowledge Dimension			
Naturalization / Articulation		Precision	Manipulation	Imitation			Factual	Conceptual	Procedural	Metacognitive
Innovative		Complex		Simple	Cognitive Dimension					
					Recall	Remembering				
						Understanding	1.1, 1.2	1.4		
				C.1	Procedural	Applying			1.3, 1.5, 1.6	
						Analysing				
					Critical Thinking	Evaluating				
						Creating				

Unit C: Tools and Materials
Hand Tools

C.1	Students are expected to… **practise tool proficiency through selected carpentry projects using a variety of hand tools.**

Achievement Indicators
Students who have achieved this outcome should be able to…

C.1.1 identify a variety of measuring tools, cutting tools, and assembling tools;

C.1.2 explain the safety precautions required for the hand tools used to compete carpentry tasks within the CAR701A course;

C.1.3 apply correct procedures to properly handle, store, and maintain hand tools;

C.1.4 choose the appropriate hand tools to complete specific tasks;

C.1.5 apply correct procedures for the safe and effective use of common hand tools; and

C.1.6 apply procedures used to install and remove fasteners and connectors using hand tools.

Technical Skill Dimension					Portable Power Tools		Knowledge Dimension			
Naturalization / Articulation		Precision	Manipulation	Imitation			Factual	Conceptual	Procedural	Metacognitive
Innovative		Complex		Simple	Cognitive Dimension					
					Recall	Remembering				
						Understanding	2.1	2.8	2.6	
				C.2	Procedural	Applying		2.7	2.2, 2.3, 2.4, 2.5, 2.9, 2.10	
						Analysing				
					Critical Thinking	Evaluating				
						Creating				

Unit C: Tools and Materials
Portable Power Tools

C.2	Students are expected to… **practise tool proficiency through selected carpentry projects using a variety of portable power tools.**

Achievement Indicators

Students who have achieved this outcome should be able to…

C.2.1 identify a variety of portable power tools used in carpentry;

C.2.2 practise the safe operation of portable saws;

C.2.3 practise the safe operation of portable planing and shaping equipment;

C.2.4 practise the safe operation of portable drilling and fastening equipment;

C.2.5 practise the safe operation of portable abrasive tools;

C.2.6 explain the safety precautions required for the portable power tools used to complete carpentry tasks within the CAR701A coursework;

C.2.7 apply correct procedures to properly handle, store, and maintain portable power tools;

C.2.8 choose the appropriate portable power tools to complete specific tasks;

C.2.9 apply correct procedures for the safe and effective use of portable power tools; and

C.2.10 apply procedures used to install and remove fasteners and connectors using portable power tools.

Technical Skill Dimension					Stationary Power Tools		Knowledge Dimension			
Naturalization	Articulation	Precision	Manipulation	Imitation			Factual	Conceptual	Procedural	Metacognitive
Innovative		Complex		Simple	Cognitive Dimension					
					Recall	Remembering				
						Understanding	3.1	3.7	3.5	
				C.3	Procedural	Applying		3.6,	3.2, 3.3, 3.4, 3.8, 3.9	
						Analysing				
					Critical Thinking	Evaluating				
						Creating				

Unit C: Tools and Materials
Stationary Power Tools

C.3	Students are expected to… **practise tool proficiency through selected carpentry projects using a variety of stationary power tools.**

Achievement Indicators

Students who have achieved this outcome should be able to…

C.3.1 identify a variety of stationary power tools used in carpentry;

C.3.2 practise the safe operation and regular maintenance of stationary saws;

C.3.3 practise the safe operation and regular maintenance of stationary planing tools;

C.3.4 practise the safe operation and regular maintenance of stationary drilling, grinding, and sanding tools;

C.3.5 explain the safety precautions required for the stationary power tools used to complete carpentry tasks within the CAR701A coursework;

C.3.6 apply correct procedures to properly operate and maintain stationary power tools;

C.3.7 choose the appropriate stationary power tool to complete specific tasks;

C.3.8 apply correct procedures for the safe and effective use of stationary power tools; and

C.3.9 apply procedures used to prepare materials for proper fastening and connecting procedures.

Elaboration

Hand tool skill development is intended to be an integrated component of the course. Students will develop their skills through work on meaningful projects designed to offer a variety of learning opportunities. They will develop the knowledge, ability, and competency to: use a variety of the hand tools listed below for the construction of projects using solid wood and manufactured materials; demonstrate the effective use of PPE; demonstrate safe practices; demonstrate the ability to read and follow plans and procedures; sharpen and maintain hand tools.

Measuring Tools	Cutting Tools	Assembling Tools
framing square combination square angle (speed) square tri-square, spirit level marking gauge chalk line plumb bob sliding t-bevel compass & dividers centre punches self-centering punches	**Stationary & Portable Tools** sliding compound mitre saw (crosscutting, mitre) band saw (curves, angles, relief cuts) jigsaw circular saw **Hand Tools** handsaws (crosscut, rip, back, coping, keyhole, hacksaw) chisels bevel utility knives sheers and aviation snips	hammers (claw, ripping) staple gun, hammer tacker nail sets & nail pullers screwdrivers (various styles) pliers, wrenches, vice grips (various styles) bar clamps spring clamps c-clamps hand screw clamps web or band clamps flat bars

Drilling Tools	Planing & Shaping Tools	Other Tools
Stationary & Portable Tools drill press (boring holes, changing bits) cordless and corded drills screw guns biscuit joiners electric/pneumatic powered nailers **Hand Tools** geared hand drill various systems for drill bit sizing (fractional, imperial, metric)	**Stationary & Portable Tools** disc and belt sanders thickness planer jointer router table & routers portable belt sanders finishing sanders & disc sanders grinders dremel tools **Hand Tools** planes (jointer, jack, smoothing, block, spoke shave) files and rasps sanding blocks, sandpaper (grit identification)	box and pan brake metal rollers metal shears welders

Performance Indicators

Some possible performance tasks associates with this outcome are listed below.

- Identifying various portable power saws used in the carpentry trade.
- Maintaining power saws and accessories, including: extension/power cords; blades; guards.
- Demonstrating an understanding of the safety issues specific to each power tool.
- Demonstrating the proper use and safety precautions to be taken with each of the power tools listed.
- Describing the use and function of portable planing and shaping tools.
- Demonstrating the use of the appropriate PPE.
- Maintaining portable planing and shaping equipment.
- Identifying portable drilling and fastening equipment.
- Describing the function and use of portable drilling and fastening equipment.
- Identifying portable abrasive tools.
- Demonstrating the ability to read and follow plans and procedures.
- Identifying and describing the main parts of a table saw, radial arm saw, and band saw.
- Demonstrating safety procedures needed when using stationary saws such as proper setup of saw blade height and angle, proper installation and functioning of guards, and the proper setup and use of the mitre gauge and fence.
- Demonstrating lock-out/tag-out procedures while performing maintenance on stationary power tools.
- Practising basic maintenance e.g., table saw (change blades, clean); band saw (set blade tension and track, set guides); radial arm saw (change blades, check alignment, set height, change fence).
- Identifying and describing the parts of a stationary jointer.
- Describing the function and use of a jointer.
- Demonstrating jointing a face, jointing an edge, and special cuts (e.g., rabbet, chamfer, angle).
- Identifying and describing the parts of a stationary planer.
- Describing the function use and cutting action of a planer.
- Demonstrating planing a board.
- Practising basic maintenance and ensuring guards are working properly.
- Demonstrating the proper cleaning and maintenance of jointers and planers.
- Identifying and describing the parts of a stationary drill press, a grinder, and a sander.
- Describing the actions and application of a drill press (boring holes, changing bits, drum sanding), a disc and belt sander, and a grinder (tool rest grinding wheels, guards).
- Practising basic sander maintenance (e.g., cleaning/changing belts and discs, setting tables, checking tracking of belt).
- Demonstrating the proper cleaning and maintenance of a drill press, grinder, and sander.
- Demonstrating the safe operation of stationary power tools (maintaining a clear working area around saw; not talking to operator; following safety rules; wearing appropriate PPE).
- Developing proficiency in the proper use of the above power tools.
- Completing projects designed to build skills in the use of these power tools.

National Occupational Analysis - Carpenter 2013

Task 1 - Uses and maintains tools and equipment.

Required Knowledge	Sub Tasks
K 1 - manufacturers' specifications K 2 - types of hand tools such as boring, cutting, abrading, planing, assembly, dismantling, measuring, squaring, marking, and clamping tools K 3 - RPM ratings for blades and discs and the importance of matching this rating to power tool RPM K 4 - types of portable power tools such as electric, pneumatic, battery-powered, and gas-powered K 5 - types of stationary tools such as table saws, planers, and jointers K 6 - types of powder-actuated tools and shots K 7 - safe operating procedures for powder-actuated tools K 8 - licensing and training requirements for the use of powder-actuated tools, chainsaws, and power elevated work platforms K 9 - types of fasteners K 10 - safety precautions, hazards, risks, and safe work procedures K 11 - types of lifting, rigging, and hoisting equipment K 12 - components of lifting, rigging, and hoisting equipment K 13 - hand signals for lifting, rigging, and hoisting K 14 - rigging and hoisting practices such as load weight calculations, working load limits (WLL), and sling angles K 15 - knots and hitches K 16 - regulations and requirements for the operation of material handling and access equipment such as zoom booms, skid steers, and fork lifts K 17 - types of layout instruments/equipment such as total stations, digital theodolites, laser levels, and builder's levels K 18 - basic survey theory and terminology	A-1.01 - Maintains hand, power, and pneumatic tools. A-1.02 - Maintains stationary tools. A-1.04 - Uses lifting, rigging, and hoisting equipment. A-1.05 - Uses layout equipment.

Technical Skill Dimension					Measuring Skills		Knowledge Dimension			
Naturalization	Articulation	Precision	Manipulation	Imitation			Factual	Conceptual	Procedural	Metacognitive
Innovative		Complex		Simple	Cognitive Dimension					
					Recall	Remembering				
						Understanding				
		D.1			Procedural	Applying				
						Analysing		1.5	1.1, 1.2, 1.3, 1.4	
					Critical Thinking	Evaluating				
						Creating				

Unit D: Carpentry Skills
Measuring Skills

D.1	Students are expected to… **demonstrate the accurate transfer of measurements from a plan to the required material.**

Achievement Indicators
Students who have achieved this outcome should be able to…

D.1.1 demonstrate accurate measurements to 1/16” and 1mm using a standard tape measure;

D.1.2 demonstrate methods for drawing a line parallel to a board’s side using a combination square;

D.1.3 demonstrate methods for drawing a line at 90 and 45 degrees using a framing square;

D.1.4 demonstrate methods for checking for level and plumb using a carpenter’s level; and

D.1.5 examine the uses of other measurement devices.

Technical Skill Dimension					Carpentry Projects		Knowledge Dimension			
Naturalization / Articulation		Precision	Manipulation	Imitation			Factual	Conceptual	Procedural	Metacognitive
Innovative		Complex		Simple	Cognitive Dimension					
					Recall	Remembering				
						Understanding			2.1	
					Procedural	Applying			2.4, 2.7, 2.10	
						Analysing			2.2, 2.3, 2.5, 2.6	
		D.2			Critical Thinking	Evaluating			2.8	2.11
						Creating			2.9	

Unit D: Carpentry Skills
Carpentry Projects

D.2	Students are expected to… **construct carpentry projects and perform technical tasks with increasing proficiency and increasing technical skills.**

Achievement Indicators

Students who have achieved this outcome should be able to…

D.2.1 identify the required tools, skills, time lines, and safety practices associated with a given project;

D.2.2 reference plans and designs to develop a work procedure and bill of materials;

D.2.3 demonstrate the accurate transfer of measurements from a plan to the required material;

D.2.4 practise making accurate cuts to lumber and/or sheet material;

D.2.5 demonstrate the safe and efficient use of required tools (hand, power, stationary);

D.2.6 demonstrate proper safety practices and procedures related to carpentry tasks;

D.2.7 apply related essential skills to carpentry tasks;

D.2.8 perform assigned carpentry tasks safely and efficiently;

D.2.9 construct projects using a variety of cutting, shaping, and boring procedures;

D.2.10 assemble projects using the appropriate joinery and/or fasteners; and

D.2.11 reflect on personal skills, attitudes, work habits, and the final product.

Elaboration

The purpose of the outcomes in Unit D is to allow students the opportunity to begin to develop the technical skills required to complete Carpentry projects. This may take the form of either small scale or large scale projects.

It is critical that each student be assessed on their ability to meet the outcomes in this unit. Often with group tasks or large builds it can be difficult to ensure that each student has had the opportunity to experience the learning. To address this situation it is recommended that teachers develop a series of small individual task assignments that can be completed throughout the course. These Carpentry tasks will allow students to practise and hone their technical skills and provide an opportunity for the teacher to give descriptive feedback to the learner and help them progress through the course.

Project work must take into account the experience level and interests of the learner. Teachers need to develop clear success criteria for project work and find a balance between assessing final projects and the learning process. This is critical as it is important that students feel empowered to challenge themselves and take risks without fear of failure.

One of the most fundamental skills involves the practical application of numeracy through the use of measurements and technical drawings. The ability to accurately interpret, transfer, and cut to specifications or plans in fundamental to the success of a Carpentry project. Students should be given time to practise and refine this skill.

Task 5 - Interprets Documentation.

Required Knowledge	Sub Tasks
K 1 - types of drawings such as site, architectural, structural,mechanical, and as-builts K 2 - drawing components such as lines, symbols, legends, and schedules K 3 - client and manufacturers' specifications K 12 - importance of maintaining accurate and thorough records	B-5.01 - Interprets project drawings. B-5.02 - Interprets specifications.

Task 6 - Organizes Work.

Required Knowledge	Sub Tasks
K 1 - task requirements (material, tools, labour) K 2 - how to coordinate necessary components to be installed by other trades K 3 - project schedule and task sequence	B-6.01 - Schedules work sequence. B-6.03 - Performs quantity take off. B-6.04 - Organizes materials.