Metals Processing 110

New Nouveau Brunswick

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Introduction

Background

Metal Processing 110 introduces students to applications of math, drafting and manufacturing processes. Students develop the dexterity required to safely operate hand tools & stationary equipment. Throughout the course, students are presented with problems that require literacy/math/science skills, and challenge logic comprehension to build and manufacture products/components for almost unlimited applications. Throughout the course, students will be presented with authentic situations in which they will make use of grade appropriate math and science skills/knowledge. They will also need to call on their problem-solving skills, logical-thinking, spatial-relations and tool skills. This course prepares students to enter professions that require critical thinking to design, evaluate and/or work with people to build devices and building components. Students will learn valuable safety procedures and tool skills.

In order to successfully achieve the goals set forth by this curriculum, class size is limited to a maximum of twenty (20) students. It must be noted that the class size may be further limited based on the physical space available to offer a safe working environment for our students.

It is highly recommended that instructors of this course have relevant knowledge and experience with the safe use of hand and machine tools as required in this curriculum.

Guiding Principles

Metals Processing 110 curriculum and resources focus on having students become …

Guiding Principles	Look For
• Projects are to reflect students'/communities' reality • Students are to engage in cross-curricular activities • Authentic applications of literacy and numeracy will be evident • Instruction will be both theory-based and application-based • Safety will be afforded the utmost respect at all times • Students' awareness of how things are made will be broadened throught this course	• Safety protocols & procedures for working in a trades environment • Dexterity (hand tools coordination) • Precision in measurement (in conjuction with the use of tools) • Computational skills (numbers/drawings to finished product and vice versa) • Numeracy comprehension (in conjuction with the use of materials/tools) • Literacy comprehension (in conjuction with the research and presentation of safety/materials/tools/etc.) • Development of understanding of the trade options available • Student understanding of how metals processing is, at the very least, at the base of most manufactured goods

Purpose

Metals Processing 110 presents opportunities for students to use math and science in relevant and interesting ways. This production-orientated course integrates concepts of appropriate material selection, significance of design, appropriate levels of precision, and the necessity to learn and adhere to safe practices when using hand tools and stationary equipment.

This course encourages students to use and develop the right side of the brain (expressive and creative side) while incorporating the analytical skills required to design and build products. Students will learn skills required to manipulate hand tools and stationary equipment, in addition to precision skills and opportunities to practice creativity.

Metals Processing 110 focuses on building transferable skill sets useful to students who are planning to enter post-secondary education in the fields of engineering, mechanical technology, industrial mechanics, machinists, computer numerical control, welders/fitters, plumbing and heating, automotive, heavy equipment, or virtually any trade.
Numeracy and literacy are important components of this course. To cultivate numeracy and literacy skills, students will demonstrate proper evidence of planning through the use of written instructions, planning sessions, drafting of project designs, and layout of metals projects.

Students will practice reading and viewing strategies when reviewing materials to be shaped through the use of hand tools and stationary equipment. Writing and representing will be practiced when students describe the operations followed to manipulate machinery to produce products.

Approaches to Teaching

New Brunswick is committed to the implementation of inclusionary practices in all courses. Metals Processing 110 allows students to assume responsibility for their own learning by using real world applications in a variety of learning methods including, but not limited to: problem-based learning, scaffolding, step-by-step tutorials/mini assignments and inquiry-based learning. Inquiry-based learning is a complex process where students formulate questions, investigate to find answers, build new understandings / meanings / knowledge, and then communicate their learning to others. In classrooms where teachers emphasize inquiry-based learning, students are actively involved in solving authentic (real-life) problems within the context of the curriculum and/or community.

This curriculum assumes 90 hours of classroom instruction and learning experiences, a semester-long program. With anticipated interruptions to this time, it is essential that teachers consider an appropriate distribution of time for the specific outcomes. An integrated approach through the suggested units will allow for flexible attention to a number of outcomes within individual learning experiences and needs. It is expected that teachers will differentiate projects as required.

Universal Design for Learning

The New Brunswick Department of Education and Early Childhood Development's definition of inclusion states that every child has the right to expect that … his or her learning outcomes, instruction, assessment, interventions, accommodations, modifications, supports, adaptations, additional resources and learning environment will be designed to respect his or her learning style, needs and strengths.

Universal Design for Learning is a "framework for guiding educational practice that provides flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways students are engaged. It also "...reduces barriers in instruction, provides appropriate accommodations, supports, and challenges, and maintains high achievement expectations for all students, including students with disabilities and students who are limited English proficient." (CAST 2011).

In an effort to build on the established practice of differentiation in education, the Department of Education and Early Childhood Development supports *Universal Design for Learning* for all students. New Brunswick curricula are created with universal design for learning principles in mind. Outcomes are written so that students may access and represent their learning in a variety of ways, through a variety of modes. Three tenets of universal design inform the design of this curriculum. Teachers are encouraged to follow these principles as they plan and evaluate learning experiences for their students:

- **Multiple means of representation**: provide diverse learners options for acquiring information and knowledge
- **Multiple means of action and expression**: provide learners options for demonstrating what they know
- **Multiple means of engagement**: tap into learners' interests, offer appropriate challenges, and increase motivation

For further information on *Universal Design for Learning*, view online information at http://www.cast.org/ .

Assessment and Evaluation

Assessment is the systematic gathering of information about what students know and are able to do. Student performance is assessed using the information collected during the evaluation process. *Metals Processing 110* is conducive to the principles of Universal Design for Learning. Teachers are encouraged to accept multiple means of representation of student learning. Students are also encouraged to monitor their own progress through self-assessment strategies using goal setting and rubrics.

It is recognized that summative evaluation is usually required in the form of an overall mark for a course of study and rubrics are recommended for this task. Teachers should use checklists and rubrics as an assessment strategy. Sample checklists and rubrics are included in this document as a suggested guideline. These examplars are intended to establish a standard of learning for students to achieve. Because student achievement levels may vary from class to class, this provides an application of **UDL** by heightening the engagement of the students by communicating the standards of major projects and assignments.

Some examples of current assessment practices include:

- Questioning
- Observation
- Conferences
- Demonstrations
- Presentations
- Technology Applications (e.g., wikis, blogs, discussion forums, virtual communication)
- Self- and peer-assessment
- Learning Logs
- Projects and Investigations
- Checklists
- Rubrics
- Reflective Journals
- Simulations
- Portfolios

Curriculum Outcomes

The learning benchmarks in this course are achieved through the successful understanding and application of processes that require a mix of literacy/numeracy/science competencies, analytical skills, practical knowledge (know how) and physical dexterity. Students create products using a variety of materials and tools, at the same time reinforcing the fundamental principles of effective design. Prepared assessments and project ideas/plans are available through provided teachers' resources and the Metals Processing Resource Site (available on the Portal).

The specific curriculum outcomes (SCO's) listed under the General Curriculum Outcomes (GCO's) 1 and 2 allign themselves well with the remaining GCO's in this document. Teachers should strive to reinforce these outcomes as they address the outcomes listed under GCO's 3, 4 and 5. The teacher must be mindful of multiple SCO's being assessed within a given lesson or activity.

G.C.O. 1.0 Demonstrate the skill and knowledge required to prevent accidents		
S.C.O.	Know	Do
• 1.1 Students understand safe procedures and common potential hazards in the lab and workplace (WHMIS).	• Potential consequences for unsafe procedures • WHIMS system as it pertains to machine shop • Location and proper use of safety equipment • Proper use of personal protective equipment (PPE) • Lockout and tag-out procedures • Potential hazards of inappropriate clothing, footwear, and jewellery	• Identify locations of safety equipment • Demonstrate successful completion of WHMIS training • Demonstrate consistent use PPE

1.2 Students understand safe body mechanics (i.e. back safety, lifting, etc.) 1.3 Students understand safe tool operation.	• Back safety • Proper lifting techniques • Safe working loads • Ergonomics and body mechanics • Proper body position when using tools • Potential hazards of striking tools, chisels, punches, etc. • Potential hazards of push/ pull tools • Do's and don'ts of safe storage and transport of hand tools • Do's and don'ts safe tool setup • Potential hazards of rotating machinery	• Consistently demonstrate proper body mechanics when lifting, tooling, using hand tools and using machines • Communicate safety theory through formal ssessment • Consistently demonstrate safe operations in practical setting
G.C.O. 2.0 Demonstrate an understanding of Applied Mathematics, Working Drawings, Layout, and Measurement.		
S.C.O.	Know	Do
2.1. Students become proficient in converting from fractional inch to decimal inch, and then to the metric system.	• Place values • Equivalent fractions • Convert from fractions to decimals and vice versa	• Use conversion charts . • Record dimensions in fractional, decimal, and metric units
2.2 • Students demonstrate use of the steel rule, calipers, micrometer, dial indicators, and angle measurement devices. • Students demonstrate use of comparative measurement tools (telescopic gauges, inside/outside calipers, etc.).	• Vernier scales • Rules down to 1/64 • Estimation/interpolation • Accuracy/tolerance • Methods to ensure repeatability	• Measure using the steel rule, micrometer, and vernier calliper • Determine the appropriate measurement tool for a variety applications • Utilize a dial indicator • Use a variety of comparative measurement tools (e.g. small hole gauges, telesoping gauges, inside/outside caliper)

2.3 Students understand and interpret orthographic and isometric drawings.	• How to read drawings that are dimensioned in fractional inches, decimal inches, and metric units • How to interpret hidden lines, sectional views, exploded views, and magnified cut-away detail view	• Create isometric and orthographic drawings • Use a drawing to produce a physical project
2.4 Students demonstrate simple layout steps applicable to a project.	• How to make lines on metal • How to utilize squares and protractors (combination set)	• Employ simple layout steps applicable to a project
G.C.O. 3 Identify and develop skills required to use metal working hand tools.		
S.C.O.	Know	Do
3.1 Students identify/select appropriate hand tools for metal working processes. 3.2 Students employ hand tools to perform fundamental metal working processes. 3.3 Students apply appropriate tool maintenance procedures.	• Clamping devices • Pliers •Wrenches •Screwdrivers •Striking tools •Chisels ○ Types and uses ○ Angles and care •Hacksaw ○ Blade types ○ Choosing blades •Files ○ Filing order ○ Draw filing ○ Polishing •Reamers • Hand Threading ○ Taps ○ Dies •Hand Polishing	• Select appropriate tool for the job/task • Optimize tool use to achieve desired result • Appraise condition of tools • Perform necessary maintance

G.C.O. 4 Identify and develop skills required to use metal working stationary tools.		
S.C.O.	Know	Do
4.1 Students understand and demonstrate the safe use of drills and drilling equipment .	• Different types of drill bits used in the machinist trade. • Various drill holding devices • Set up procedures • Proper speed and feed rates • Special drill operations such as counter sinking, counter boring, tapping and reaming	• Identify, select, and safely use different types of drill machines • Maintain and properly use the different types of drill bits • Demonstrate safe use and application of drill holding devices • Calculate and apply proper speed and feed rates
4.2 Students recognize and demonstrate basic grinding skills.	• Grinder safely • Appropriate grinding wheel type and maintenance • Grinding wheel numbering designation system and types of grinding wheels .	• Apply grinder safety • Employ a ring test to check grinding wheels • Apply basic grinding techniques • Adjustment and setup of grinding machines
4.3 Students use appropriate techniques in operating cut off saws and bandsaw machines.	• Various types of cut off saws • Safe use and care of metal cut off saws and band saws • Blade terminology and selection • Hazards of metal lathe.	• Setup and use cut off saws safely

4.4 Students understand and demonstrate safe use of the engine lathe.	• The parts of lathe
	• Lathe tooling
	  ○ Cutting tools and tool holders
	  ○ Work-holding attachments
	  ○ Lathe Centers
	• Cutting speeds and feeds
	• Basic lathe operations
	• Lathe cleaning and lubrication
		• Apply lathe safety
		• Use basic lathe operations:
		  ○ Facing stock held in a chuck.
		  ○ Knurling
		  ○ Turning and turning to a shoulder
		  ○ cut a taper
		  ○ Filing and polishing
		  ○ Drilling
		  ○ Center Drilling
		  ○ Boring
		  ○ Parting
		• Calculate lathe rpm and feed rate
		• Convert angle measurements from degrees to ratios (inches per foot)
		• Proper use of cleaning utensils for removal of waste
		• Demonstrate proper start-up lubrication (ways, lead screw, etc.)

4.5 Students understand and demonstrate safe use of the milling machines.	• Milling Machine parts (Vertical Milling Machine)
	• Common milling machine tooling:
	  ○ Cutting tools and tool holders
	  ○ Work-holding equipment
	• Speeds and feeds
	• Safe milling machine operations
		• Safe operation of milling machine
		• Facing/Surfacing
		• Precision Drilling
		• Key seat and/or slot on round work
		• Basic Milling Machine Operations:
		  ○ Facing/Surfacing stock
		  ○ Squaring
		  ○ Key Seats
		  ○ Slotting
		  ○ Precission drilling
		• Calculate speeds and feeds

G.C.O. 5 Identify various careers available in the Metals Processing Industry.		
S.C.O.	Know	Do
5.1 Students identify what career opportunities may be available to them based on current & future studies.	• Carreer opportunities available to them should their highest level of training be: o Metals Processing 110 o Metals Processing 120 o Possible Pre-Apprentiship Program o Apprentiship Program o Trades College - Machinist Apprent - CNC Machinist - Mill Wright - Metal Fabrication • The various post-secondary and/or Apprentiship options available to them - as well as associated costs & benefits	• Identify different carreers in the Industry • Research future job prospects in the industry • Research entrepreneurial opportunities in the industry • Research carreer opportunities based on geographic location • Create a career training map (possible extension project)
5.2 Students identify the cross-curricular skills and knowledge they must posess in order to gain employment in the Metals Processing Industry.	• Cross-Curricular Skills o Math o Literacy o Science • Fundamental Skills o Problem Solving o Inter-Personal o Organisational o Life-Long Learning	• Complete a “Fundamental Skills” assessment – such as the one set out by Industry Canda • Participate in a Team Project (Extension) • Select a topic to practice independent learning and demonstrate their new knowledge/skills • Maintain a portfolio (paper- based, project examples or digital representations) of abilities • Research the manufacturing process of a product of interest

Suggested Units of Study in *Metals Processing 110*

Unit of Study: Safety	
Safety: This unit will introduce students to the skills and knowledge required to work safely in a trades environment. It is expected that this will be the first unit of study to be completed, and that these skills will be used in the performance of all tasks that follow. **Look fors:** **Students can:** • Identify locations of safety equipment • Demonstrate an understanding of how and when to use safety equipment • Demonstrate an awareness of potential safety concerns around them • Demonstrate an understanding of lockout and tag-out procedures • Demonstrate successful completion of WHMIS training • Demonstrate consistent use Personal Protective Equipment (PPE) • Consistently demonstrate proper body mechanics when lifting tooling and/or stock, using hand tools, posture when using machines and when reaching • Communicate safety theory through formal assessment • Consistently demonstrate safe operations in a practical setting **Note:** "Safety equipment" includes preventative devices (blade guards, etc.) as well as responsive equipment (fire extinguisher, etc.).	
Curriculum Outcomes	**Suggestions for Teaching and Learning**
1.1 Students understand safe procedures and common potential hazards in the lab and workplace (WHMIS). 1.2 Students understand safe body mechanics (i.e. back safety, lifting, etc.) 1.3 Students understand safe tool operation.	**Lesson Suggestions:** This unit requires that students receive instruction in three key safety areas: • How to recognize, avoid and respond to situations resulting from hazards • How to safely make use of one's own self (body mechanics) to accomplish tasks in a trades environment • How to safely make use of hand and stationary tools to accomplish tasks in a trades environment This unit provides an opportunity to introduce the basic concepts and skills related to these three areas. Hands-on practice is essential. It is expected that the evaluation of this unit will not rest wholly on written assessments – practical, authentic evaluation of these outcomes must be done before performing certain tasks, as well as on an on-going basis throughout the course. *Hazards in the trades environment.* This section addresses the first six (6) look fors. • Introduce the students to the shop space and inform them of the location of the safety equipment (responsive – Fire Blanket, etc.) • Explain the proper use of each piece of safety equipment and demonstrate an application • Explain the rational behind lockout and tag-out procedures as well as the proper steps that need to be taken

- Tour the shop space and have students point out and discuss potential hazards such as scrap material lying around, noise levels, etc.

- Introduce the idea of there being some less obvious hazards such as chemicals, fumes, etc., and speak about WHMIS training

- Set students up for WHMIS training and have them follow the necessary steps to become certified

- http://www.hc-sc.gc.ca/ewh-semt/occup-travail/whmis-simdut/index-eng.php (What is WHMIS?)

- Worksite Safety online course ($34.95 per user for general public)

- NBCSA can supply usernames and passwords to allow access to WHMIS and Safety Orientation **free of charge** for students and teachers (Contact your principal to initiate this request)

Body Mechanics

- Have students present what they know about proper body mechanics in the areas of lifting, reaching, bracing, etc.
- Challenge students to demonstrate the proper body mechanics of typical tasks that they will need to perform
- Have students create, with a partner, a safety video that will show basic shop safety and body mechanics (where possible)

Making use of hand tools and stationary tools

- Show students how to safely use hand tools available to them.
  - Clamping tools
  - Pliers
  - Wrenches
  - Screw drives
  - Striking tools
  - Chisels
  - Hacksaw
  - Files
  - Reamers
  - Hand Threading
  - Hand Polishing

- Show students how to safely use the stationary tools available to them.
  - Drill Press
  - Bench Grinder
  - Band Saw
  - Cut-Off Saw
  - Engine Lathe
  - Milling Machine

	• Have students demonstrate how to safely use each tool. This can be done throughout the semester as a tool is needed for a project. Maintain a record (check list) for each student for each category of tool. • Before a student is permitted to use a stationary tool on the following day, they must demonstrate proper safety procedures once again. This time, it will be to a peer, as opposed to the teacher. The peer will have access to the safety checklist (located by the tool) and make sure that nothing was missed. This second evaluation could be noted on the student's check list as well. Notes: - Throughout the semester, students should be monitored for Safe Practices. - Periodically asking students to look around for potential hazards (and identifying them) would serve as a good review. - Throughout the semester, secretly create some hazards (scrap material lying on the floor, a striking tool stored on an overhead surface, etc.) and ask the students to identify them before anyone is allowed to work in the shop that day. - Throughout the semester, secretly remove a safety device (i.e.the blade guard on a band saw) and lock out the power to the machine. It will be quite informative to see if someone notices there is no power before they notice there is no guard. - Students should be encouraged to monitor each other in the shop. It is important to create a culture that promotes helpful reminders (should someone be doing something unsafe) as opposed to a culture that considers the interaction to be punitive, demeaning, or an attempt to "tattle". Supporting Sections in the textbook **Machining Fundamentals**: - Chapter 2 : Shop Safety (Safety in a shop, General machine safety, General tool safety, Fire safety) - Chapter 5: Layout Work (Layout safety) - Chapter 7: Fasteners (Fasteners Safety) - Chapter 10: Drills and Drilling Machines (Drill Press safety) - Chapter 11: Offhand Grinding (Abrasive Belt and Grinder safety) - Chapter 12: Sawing and Cut-off Machines (Power Saw safety)

	- Chapter 13: The Lathe (Lathe safety) - Chapter 17: The Milling Machine (Milling safety practices) - Chapter 19: Precision Grinding (Grinding safety) - Chapter 25: Heat Treatment of Metals (Heat-treating safety)

Safety Marking Checklist/Rubric

Safety Equipment (Responsive)		
Student is able to locate all safety equipment required for the trades environment	Y	N
Student is able to explain when and why the safety equipment would be needed	Y	N
Student is able to explain the how to use each piece of safety equipment	Y	N
Possible Safety Concerns in the Physical Environment		
Student is able to identify potential hazards in his/her work area	Y	N
Student is able to offer appropriate solutions to remove the presence of potential hazards	Y	N
While working in the shop, the student avoids creating potentially hazardous situations …		
… by how they act	Y	N
… by maintaining a tidy/orderly environment	Y	N
Lockout and Tag-out		
Student can explain the importance of lockout and tag-out as well as when to do it	Y	N
Student is able to demonstrate the appropriate procedure	Y	N
WHMIS Certification		
Successfully completed WHMIS training.	Y	N
Teacher has copy of WHMIS certification on file.	Y	N
Personal Protective Equipment		
Student is able to identify the different types of PPE required in the trades environment	Y	N
Student demonstrates appropriate use of PPE	Y	N
Body Mechanics		
Student demonstrates proper body mechanics for …		
… lifting	Y	N
… reaching	Y	N
… using tools (posture and ability to brace one's body for better control over tools)	Y	N

Safe Use of Hand Tools		
Clamping tools	Y	N
Pliers	Y	N
Wrenches	Y	N
Screw drivers	Y	N
Striking tools	Y	N
Chisels	Y	N
Hacksaw	Y	N
Files	Y	N
Reamers	Y	N
Hand Threading	Y	N
Hand Polishing	Y	N
Safe Use of Stationary Tools		
Drill press	Y	N
Bench grinder	Y	N
Bandsaw	Y	N
Cut-off saw	Y	N
Engin lathe	Y	N
Milling machine	Y	N
Total number of Y, N		

Rating __Very knowledgeable and conciencious when it comes to safety – consistent safe practice
__ Good theory based results on safety yet not consistent in practice
__ Needs to work on theory and practice before entering or re-entering the lab

Comments

Unit of Study: Bench Work

Bench Work: This unit will introduce students to skills required in the use of hand tools and various power tools. These skills may be used in the performance of tasks such as blue print reading, measurement, layout, sawing, drilling, hand filing and finishing, threading and tapping of bolts and holes, hand polishing, and assembly and disassembly mechanical projects.

Look fors:

Students can:

- Read drawings that are dimensioned in fractional inches, decimal inches, and in metric units
- Interpret and explain information found on a typical mechanical drawing
- Use tolerance information in the production of an acceptable part
- Measure to 1/64”(0.5 mm) with a steel rule
- Measure to 0.0001” (0.002 mm) using a micrometer
- Measure to 0.001 (0.02 mm) using vernier measuring tools
- Measure angles
- Identify and use different gages, dial gages, and various helper measuring tools found in a shop
- Explain why layout is needed
- Identify common layout tools
- Make basic layouts
- Identify commonly used machine shop hand tools
- Select appropriate hand tools and demonstrated their use
- Safely operate drilling equipment
- Calculate correct speeds and feeds for drilling operations

Curriculum Outcomes	Suggestions for Teaching and Learning
2.1. Students become proficient in converting from fractional inch to decimal inch and then to the metric system. 2.2 • Students demonstrate use of the steel rule, calipers, micrometer, dial indicators, and angle measurement devices. • Students demonstrate use of comparative measurement tools (telescopic gauges, inside/outside calipers, etc.) 2.3 Students understand and interpret orthographic and isometric drawings. 2.5 Students demonstrate simple layout steps applicable to a project.	**Lesson Suggestions:** This unit requires that students receive instruction in four key machining areas: understanding drawings, measurement, layout and hand tool use. This unit provides an opportunity to introduce the basic concepts and skills related to these four areas. Hands-on practice is essential. *Understanding Drawings* • Introduce understanding drawings by creating a lesson based on the material in sections 3.1, 3.2, 3.4, and 3.7 of “Machining Fundamentals” • Examples of drawings that students can practice with can be found on pages 27 to 37 of the instructor’s manual. • Provide students with simple objects and have them create a “shop” drawing of that object. (Technology can be used if available) • Explain the basic principles of dimensioning and the use of tolerances on drawings. • Explain the importance of parts being made as presented in the drawing and the need for enough detail to ensure that all features are machined correctly. *Measuring* • Have students examine and handle a variety of measuring instruments including the steel rule, micrometer, vernier caliper, dial caliper, digital caliper, height gage, and bevel protractor –as available. • Demonstrate the use and application of each of the above tools to the students either individually, in groups, or as whole class instruction. • Information on how to read the various scales, including verniers, can be found in sections 4.1 to 4.3 of “Machining Fundamentals”.

3.1 Students identify/select appropriate hand tools for metal working processes. 3.2 Students employ hand tools to perform fundamental metal working processes. 3.3 Students apply appropriate tool maintenance procedures. 4.1 Students understand and demonstrate the safe use of drills and drilling equipment .	• Practice exercises for reading various measurement devices can be found in text book. Blackline masters for practice are found in the instructor's manual. • Have students practice measuring various objects with different instruments. Students will need practice in both manipulating the measuring device and in interpreting the results. Students should try to produce consistent repeatable results. • Explain how to select an appropriate measuring device based on usage and precision required. *Layout* • Explain the use of layout lines and why they are important to use in machining. • Demonstate the proper application of layout bluing –or equivalent. • Demonstrate the use of simple layout tools such as scribers, squares, protractors, surface gages, etc. • Give students a simple drawing and have them layout the appropriate lines on a practice piece. • Section 5.1 to 5.4 of the text can be used as a resource. *Hand Tool Use* • Show students various hand tools that are available in the shop, and explain the safe care and use of these tools. • Show how to select hand tools according to the project/job that needs to be accomplished. • All students should see a demonstration of proper sawing (hack saw) and filing techniques. • Reference material can be found in chapter 6 of "Fundamentals of Machining" • Demonstrate the safe use of drilling machines and the proper selection of drills. **Skills Practice:** As each area above is studied, students will need opportunities to practice new skills. Both the text book and instructor's resource contain practice material. Hand skills such as filing, layout, drilling, and sawing can be practiced in most shops. Students will benefit the most by completing a project that required them to utilize all of their new skills. Suggest projects include: • Drill Gage Project • Rolling Die Project • Tapping Plate Project *see Appendix C for a list of project suggestions.

Unit of Study: Machine Work

Machine Work: This unit will introduce students to skills required in the use of metal working machine tools with a primary focus on the metal lathe. Students will develop the necessary theoretical knowledge and practical skills needed to complete basic projects requiring the use of machine tools. Projects will focus on developing fundamental skills in the operation of the metal lathe and in the basic use of the milling machine. Other support machines such as the bench grinder, cut-off saw, and drill press will be addressed as necessary for the completion of projects.

Look fors:

Students can:

- Safely operate sawing and cut-off machines
- Safely use a bench grinder
- Describe how a lathe operates
- Identify the major components of a lathe
- Safely and correctly operate a lathe to perform basic lathe operations
- Sharpen lathe cutting tools
- Safely and correctly use a milling machine to perform basic precision milling operations
- Select and use correct mathematical formulae to determine machine feeds and speeds

Curriculum Outcomes	Suggestions for Teaching and Learning
4.1 Students understand and demonstrate the safe use of drills and drilling equipment. 4.2 Students recognize and demonstrate basic grinding skills. 4.3 Students use appropriate techniques in operating cut off saws and band saw machines. 4.4 Students understand and demonstrate safe use of the engine lathe. 4.5 Students understand and demonstrate safe use of the milling machines.	**Lesson Suggestions:** This unit requires that students receive instruction in the use of basic metal working machines. Students will be required to prepare stock using a cut-off machine, perform some basic grinding operations (sharpening, shaping, or de-burring), operate a drill press, operate a milling machine, and operate a lathe. A project should be chosen that allows for the use of all of the above tools. Hands-on practice is essential. *Cut-off Saws* • A lesson introducing the theory of cut-off saws can utilize information found in Chapter 12 of the text. Instructors should select information that is relevant to the equipment found in their shops. At a minimum material should be covered that examines proper blade selection, determination of cutting speeds and feeds, and safe/efficient work holding strategies for various material shapes. • A whole class or small group demonstration could be used to illustrate safe and proper use of the machine. • Students should have the opportunity to prepare their own stock for the project they are working on. *Grinding* • A lesson introducing the theory and safe operation of a bench grinder can be prepared by using selected material from Chapter 11 of the text. Information concerning the sharpening of HSS lathe cutter bits can be found in chapter 13 of the text. • Instructor could demonstrate how to test a grinding wheel for fracture and how to properly mount the wheel. • Instructor could demonstrate how to shape and sharpen a HSS lathe cutter bit from a blank piece. Students could then create and/or sharpen cutter bits for their own use in the shop. • Instructor could demonstrate how to sharpen a HSS drill bit and have students practice this skill. This would give students an opportunity to use the drill gage, if they had chosen to construct this project earlier.

Drill Press

- A lesson introducing the theory and safe operation of a drill press can be prepared by using selected materials from Chapter 10 of the text. This chapter contains information about selecting the proper spindle speed based on tooling and material. Students should be given an opportunity in this lesson to practice finding appropriate feeds and speeds for drilling operations.
- A whole class or small group demonstration of how to adjust speeds and operate the drill press safely could be done.
- There are several online videos available (see Appendix A) that could supplement instruction.

Metal Lathe

- Whole class or small group instruction can be used to introduce students to the lathe. Students should be given the opportunity to practice identifying and using the different controls of the lathe.
- Students should be given the opportunity to practice basic lathe operations such as facing, plain turning, drilling, boring, and taper turning. A whole class or group demonstration can be used to introduce each of these operations. Students should see the procedures used from setup to finish including selection of work holding devices, tooling and calculation of feeds and speeds. Simple plans for practice items can be found in Section 2 - Lathe Competency- of *Machining Projects*.
- A series of lessons should be prepared to cover operations as needed for the completion of a selected lathe project. Chapters 13 to 15 of the textbook contain information on lathe work. Selected sections of the text can be chosen to form a base for the theory component of each lesson. ***If a project is chosen from* Machining Projects*, a list of correlating text book sections is included with the operations list provided.***

Milling Machine

- Whole class or small group instruction can be used to introduce students to the milling machine. Students should be given the opportunity to practice identifying and using the different controls of the milling machine. Milling machines will not be treated in the same depth as lathes. Basic operations such as facing, drilling, and slotting may be required for some of the selected projects. Where appropriate, students should see a demonstration of these operations.
- Chapters 17 and 18 of the text book contain material that can be used to prepare lessons covering the theory of operation of milling machines. The focus should be on vertical milling machines for this curriculum.

Skills Practice:

As each area above is studied, students will need opportunities to practice new skills. Both the text book and instructor's resource contain practice material. This unit of study covers the used of several different machine tools with an emphasis on metal lathes. In order to get the most from this unit, projects should be chosen that require, or can use, most of these machines. The following are some suggested projects:

- Spring Center (tapping guide)
- Nested Scribe
- Ball Peen Hammer ***advanced***
- Deburring Tool ***advanced***
- Gravity Center Punch ***advanced***
- Tap Wrench
- Center Punch

*see Appendix C for a list of project suggestions.

Unit of Study: Career Research

Careers: This unit will introduce students to various career opportunities available in the metals processing industry. It is expected that students will gain an understanding of education requirements and future job prospects in the industry.

Look fors:

Students can:

- Identify various careers possible in the metals processing industry
- Demonstrate an understanding of the essential skills necessary to work in this industry
- Demonstrate an understanding of the apprenticeship, post secondary, and training options available

Curriculum Outcomes	Suggestions for Teaching and Learning

5.1 Students identify what carreer opportunities may be available to them based on current & future studies.
 	
5.2 Students identify the cross-curricular skills and knowledge they must posess in order to gain employment in the Metals Processing Industry.
	Lesson Suggestions:
	Career Options Assignment
	
	Go to http://www.jobbank.gc.ca/home-eng.do?lang=eng this is the job bank main page, then look for the links for Career Explorations to the Right hand side of the main page. Research career definitions or job descriptions for machinists or manufacturing/processing industries.
	
	By using your research compile your information in a word document. Include:
	• A job description
	• Statistics such as number employed in Canada, New Brunswick and local cities if available.
	• Pay scales for 3 regions of Canada, Province by province if available.
	• Job opportunities, job postings for 6 different provinces of Canada. Use Career Beacon http://www.careerbeacon.com to research jobs
	• Locate welding shops or related industries in our area and compare that with another region of Canada. You can use www.Canada 411.ca to locate welding industries
	• Use the Job Bank site to explore apprenticeship requirements and licensing requirements for machinists.
	  ○ What is the Red Seal program and how do you get a red seal?
	• Use the Employment and Social Development Canada website to explore Literacy and Essential Skills and Trades and Apprenticeship.
	  ○ Under the Essential skills heading compare the Machinist trade to one or two other trade areas, list what essential skills are the same?
	  ○ Under the Trades and Apprenticeship heading what grants are available for trade areas?
	
	Answer all the above areas using a reporting method; Prezi, Power Point, Photo Storey, Audio file and/or a Word document. Organize your information in a way that would be easy for someone other than you, to read through and understand. You should approach this assignment as if you were looking into a trade as a career option in the near future.

Metals Processing 110

Assessment of Student Classroom/Lab Learning Skills

Student: _____ Teacher: _____

	Criteria				Points
	4	**3**	**2**	**1**	
Attendance / Promptness	Student is **always** prompt and regularly attends classes.	Student is late to class **once every two weeks** and regularly attends classes.	Student is late to class **more than once every two weeks** and regularly attends classes.	Student is late to class **more than once a week** and/or has poor attendance.	____
Preparation	Prepared for class (theory and practical).	Usually prepared for class (theory and practical).	Occasionally prepared for class (theory and practical).	Seldom or never prepared for class (theory and practical).	____
Lab Organization and Management	Maintains clean work area. Assists others when necessary.	Usually maintains clean work area. Sometimes assists others.	Seldom maintains work area. Rarely assists others.	Does not maintain work area. Never assists others.	____
Class Participation and Communication	Participates in all classes. Questions when uncertain to ensure correct procedures are followed.	Usually participates (theory and practical). Occasionally asks for clarification when unsure of procedures.	Occasionally participates (theory and practical). Rarely asks questions to clarify procedures.	Little or no participation (theory and practical). Never asks questions to clarify procedures.	____
Behavior	Student **almost never** displays disruptive behavior during class.	Student **rarely** displays disruptive behavior during class.	Student **occasionally** displays disruptive behavior during class.	Student frequently displays disruptive behavior during class.	____
General Safety Procedures	Respects all safety procedures.	Usually respects safety procedures.	Often ignores safety procedures.	Ignores safety procedures.	____
				Total---->	____

Teacher Comments:

Appendices

Appendix A: Potential Project Resources

The following is a list of potential sources of information to assist in designing and choosing hands-on projects for Metals Processing 110:

Web Resources

(As with all web resources, you must preview any material you want to share with students as the content is not monitored by the EECD and can change from day to day.)

https://portal.nbed.nb.ca/sites/techvoc/metalsprocessing/default.aspx
Metals processing portal website hosted by the New Brunswick Department of Education.

http://www.projectsinmetal.com/
This site provides free plans for projects. Registration is required.

http://thatlazymachinist.com/
MARC L'ECUYER, a retired machine shop instructor, created this bilingual site that includes instructional videos and information on machine shop practice and the construction of basic projects.

http://www.tormach.com/resources.html
This site contains machine shop learning resources provided by Tormach. Their focus is on CNC processes, but there are many videos and project ideas that can be applied to Metals Processing 110.

http://www.smithy.com/training-videos
This site contains machine shop training videos about the lathe and milling machine produced by Smithy machine tools. Their focus is on the use of Smithy products, but the processes are applicable to other machines. Other resources including machining projects can be found on this site.

http://www.jjjtrain.com/vms/
Virtual machines shop training course.

https://techtv.mit.edu/collections/ehs-videos
This is a collection of machine shop training videos available from MIT's techtv website. They cover both bench work and machine work.

Print

Machining Projects by David O. Averyt, published by Goodheart-Wilcox Company, Inc.

This book contains plans and projects that are correlated with sections in the prescribed textbook.

Appendix B: Supplementary Machining Reference Texts

The following is a list of supplementary reference texts that may help support instructors and students in Metals Processing 110:

References

Machinery's Handbook published by Industrial Press Inc.

Machinists' Ready Reference published by Prakken Pulbications

Shop Reference for Students and Apprentices published by Industrial Press Inc.

The Starrett Book for Student Machinists published by The L.S. Starrett Company

Appendix C: Suggested Projects

The following is a list of suggested projects to fulfill the hands-on component of Metals Processing 110:

(A more comprehensive collection of resources can be found in the Metals Processing portion of the Portal.)

Project	Plans and Information source (*see appendix A for source details*)
Drill Gage	**https://portal.nbed.nb.ca/sites/techvoc/metalsprocessing/default.aspx** ***Machining Projects*** by David O. Averyt **http://thatlazymachinist.com/** That Lazy Machinist Youtube video of drill gage project http://www.youtube.com/watch?v=mjfbIiWT_5k
Rolling Die	**https://portal.nbed.nb.ca/sites/techvoc/metalsprocessing/default.aspx**
Tapping Plate	***Machining Projects*** by David O. Averyt
	http://www.projectsinmetal.com/

Bench Work

Machine Work

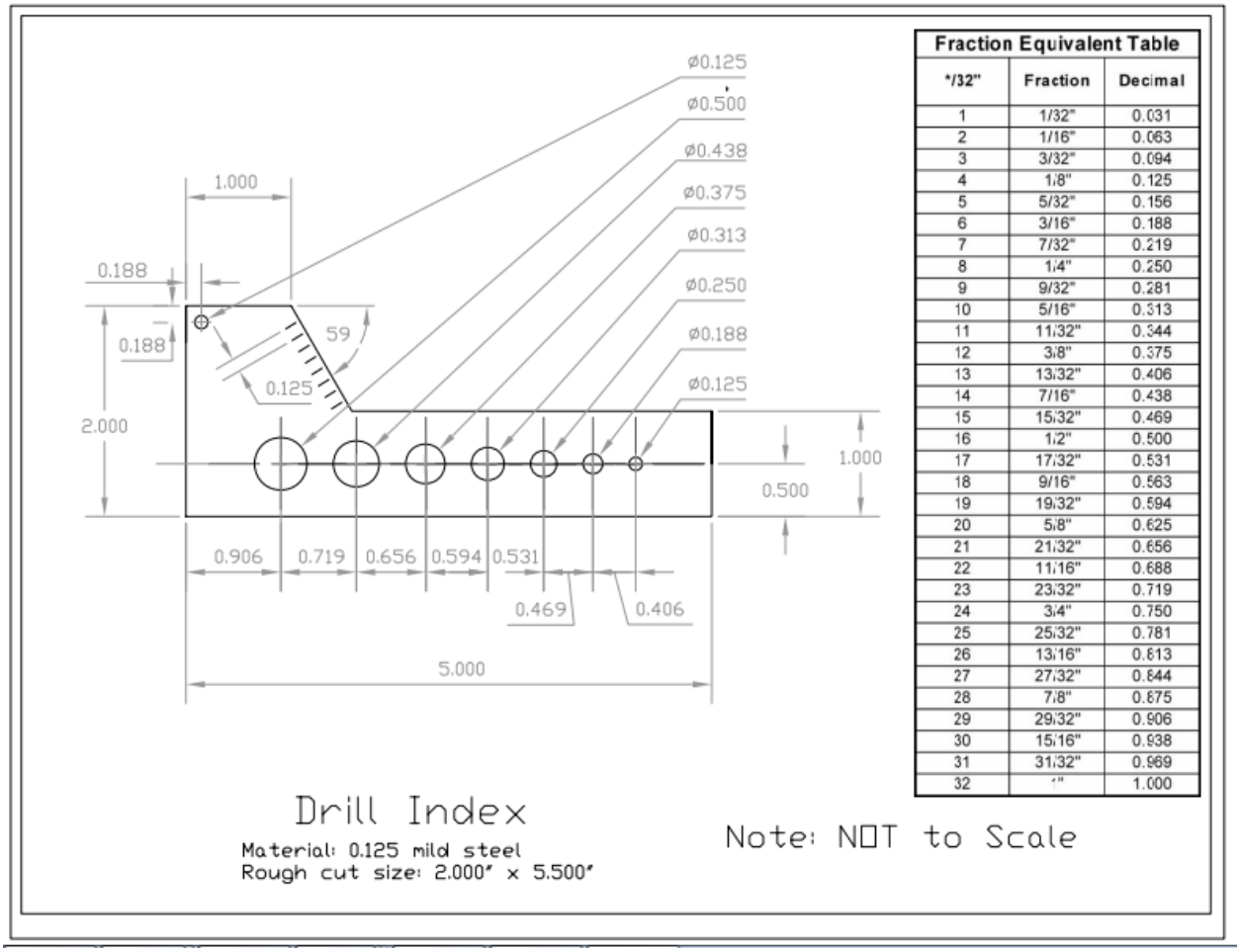
Project	Plans and Information source (*see appendix A for source details*)
Spring Center	**http://www.projectsinmetal.com/**
Nested Scribe	**http://www.projectsinmetal.com/**
Ball Peen Hammer	***Machining Projects*** by David O. Averyt
Deburring Tool	***Machining Projects*** by David O. Averyt
Gravity Center Punch	***Machining Projects*** by David O. Averyt
Tap Wrench	***Machining Projects*** by David O. Averyt
Center Punch	**https://portal.nbed.nb.ca/sites/techvoc/metalsprocessing/default.aspx**

Appendix D: Sample Project

The following is a list of sample projects to fulfill the hands-on component of Metals Processing 110. Sources for complete details about the projects can be found in appendix C.

Drill Gage

Sample Print



Fraction Equivalent Table		
*/32"	Fraction	Decimal
1	1/32"	0.031
2	1/16"	0.063
3	3/32"	0.094
4	1/8"	0.125
5	5/32"	0.156
6	3/16"	0.188
7	7/32"	0.219
8	1/4"	0.250
9	9/32"	0.281
10	5/16"	0.313
11	11/32"	0.344
12	3/8"	0.375
13	13/32"	0.406
14	7/16"	0.438
15	15/32"	0.469
16	1/2"	0.500
17	17/32"	0.531
18	9/16"	0.563
19	19/32"	0.594
20	5/8"	0.625
21	21/32"	0.656
22	11/16"	0.688
23	23/32"	0.719
24	3/4"	0.750
25	25/32"	0.781
26	13/16"	0.813
27	27/32"	0.844
28	7/8"	0.875
29	29/32"	0.906
30	15/16"	0.938
31	31/32"	0.969
32	1"	1.000

Sample Marking Guide

Marking Guide for Drill Index / Sharpening Gauge

Measurement	Possible Score	Student Score	Comments
Work length 5.000"	5		
Top edge length 1.000"	5		
Bottom width 1.000"	5		
Drill Angle 59.0 degrees	5		
Hole spacing as per drawing	20		
1/8" divisions	5		
Machining / Finishing	**********		
Edges filed flat and square	10		
Edges and corners deburred and softened	5		
Faces flattened and smooth	15		
Drill angle beveled	5		
All surfaces polished or finished	10		
Labeling	**********		
Initials and hole sizes clearly marked, positioned and legible	10		
TOTAL SCORE	**100**		

Use the following scale for marks out of 5, 10 and 15. Double for marks of 10 for out of 20

5	10	15	Comment
5	10	15	Excellent work; very accurate
4	8 – 9	13-14	Good or very good; minor flaws
	7	10-12	Satisfactory; some flaws
3	6	9	Needs improvement; many flaws
2	3 – 5	5-8	Serious flaws or inaccuracies
	1 – 2	1-4	Extremely flawed; very poorly done
0	0	0	Totally wrong or not done