

2010

Saskatchewan Curriculum

# Welding 10, 20, A30, B30



Welding 10, 20, A30, B30

ISBN: 978-1-926841-25-0

1. Study and teaching (Secondary school) - Saskatchewan - Curricula. 2. Competency-based education - Saskatchewan.

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## Acknowledgements

The Ministry of Education wishes to acknowledge the professional contributions and advice of the provincial curriculum reference committee members:

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and Superintendents

Jerry Peters, Teacher  
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Saskatchewan Teachers' Federation

In addition, the Ministry of Education acknowledges the Welding working group members:

- Dennis Muzyka, Melville Comprehensive School, Good Spirit School Division
- Gerald Nickel, North Battleford Comprehensive School, Living Sky School Division
- Rod Nieviadomy, Weyburn Comprehensive School, South East Cornerstone School Division.



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## Introduction

The Welding curriculum is designed with modules to complete four 100 hour pure courses. Modules can also be selected to use in survey courses at middle and secondary levels. Each module contains a single learning outcome with a number of indicators showing the depth and breadth of the learning required in each module. Middle level programs should only use modules labelled as Introductory.

The Saskatchewan Apprenticeship and Trade Certification Commission (SATCC) has deemed welding to be a designated trade; therefore, possible post-secondary benefits are available for secondary level welders. Under an articulation agreement between the Ministry of Education and SATCC, high school students who successfully complete the learning outcomes in the Welding curriculum under the supervision of a journeyman instructor can apply for trade-time credit when registering as an apprentice. Details of this agreement can be found in Appendix A.

## Curriculum Features

Curricula in the Practical and Applied Arts (PAA) have several features unique to this area of study. The reasons for inclusion of these features in all PAA curricula are to encourage flexibility in school programming, to establish clearly transferable skills, and to ensure the practical emphasis of the program.

PAA curricula contain all courses in a single document whether it is one course as in Entrepreneurship or five courses as in Autobody. This feature allows schools and teachers the flexibility to choose modules supportive of their students' needs as well as utilizing the available facilities and equipment. The order and number of modules can vary between schools as long as the integrity of the discipline and the required 100 hours per course are maintained.

All PAA curricula are designed using modules. To aid teachers and schools in course planning, each module is designated as Introductory, Intermediate, or Advanced. Modules may also have prerequisites which must be completed by the student as the knowledge (i.e., factual, conceptual, procedural, metacognitive) is cumulative. Core modules are the compulsory modules that must be covered in pure courses of study for developmental or safety reasons. Each module has a suggested time provided to aid teachers in the planning of their courses. Each module may take more or less than the suggested time depending on factors such as background knowledge of the students.

A third unique feature of PAA curricula is the inclusion of an optional Extended Study module in each course. The Extended Study module allows teachers to create their own outcome and indicators relevant

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to the purpose and areas of focus for the subject which will meet their students' needs. As innovations occur in the knowledge and technology of various areas of study, the Extended Study modules are one way in which teachers can ensure their programs stay current with industry practice.

Work Study modules contained in all PAA curricula encourage personalized learning and development of community relationships. Work Study is designed as a work-based learning portion of a course to provide off-campus educational opportunities for individuals or small groups in a work setting. Planning and assessment are managed by the teacher while the learning opportunity is provided by an expert in the community. Practical skills developed in school are directly transferred to a work environment.

Another feature unique to the Practical and Applied Arts is the availability of module tracking within the provincial Student Data System. This service provided by the Ministry of Education allows teachers to enter completed modules into the Student Data System and create a record and printout for individual students of all the PAA modules experienced during their school career. This record can be provided to students in their report cards, for use in their portfolio, or inclusion on a résumé.

Transferable skills are desirable as an aspect of lifelong learning. Transferable skills developed in PAA are many and varied, from operating large stationary power equipment to utilizing video editing software. The practical nature of these transferable skills enriches students' lives as they transition into post-secondary life. In Canada, two taxonomies of transferable work skills have been developed. Employability Skills have been developed by the Conference Board of Canada and Essential Skills have been identified by Human Resources and Service Development Canada. Students will be familiar with both of these taxonomies from their learning in Grade 8 Career Education.

More details on the above curriculum features are provided in the Practical and Applied Arts Handbook available on the Ministry of Education website.

## Core Curriculum

Core Curriculum is intended to provide all Saskatchewan students with an education that will serve them well regardless of their choices after leaving school. Through its components and initiatives, Core Curriculum supports student achievement of the Goals of Education for Saskatchewan. For current information regarding Core Curriculum, please refer to *Core Curriculum: Principles, Time Allocations, and Credit Policy* on the Saskatchewan Ministry of Education website.



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For additional information related to the various components and initiatives of Core Curriculum, please refer to the Ministry website at [www.education.gov.sk.ca/policy](http://www.education.gov.sk.ca/policy) for policy and foundation documents including the following:

- *Understanding the Common Essential Learnings: A Handbook for Teachers* (1988)
- *Objectives for the Common Essential Learnings (CEs)* (1998)
- *Renewed Objectives for the Common Essential Learnings of Critical and Creative Thinking (CCT) and Personal and Social Development (PSD)* (2008)
- *The Adaptive Dimension in Core Curriculum* (1992)
- *Policy and Procedures for Locally-developed Courses of Study* (2010)
- *Connections: Policy and Guidelines for School Libraries in Saskatchewan* (2008)
- *Diverse Voices: Selecting Equitable Resources for Indian and Métis Education* (2005)
- *Gender Equity: Policies and Guidelines for Implementation* (1991)
- *Instructional Approaches: A Framework for Professional Practice* (1991)
- *Multicultural Education and Heritage Language Education Policies* (1994)
- *Classroom Curriculum Connections: A Teacher's Handbook for Personal-Professional Growth* (2001).

## Broad Areas of Learning

Three Broad Areas of Learning reflect Saskatchewan's Goals of Education. Practical and Applied Arts contributes to the Goals of Education through helping students achieve knowledge, skills, and attitudes related to these Broad Areas of Learning. The Broad Areas of Learning express the desired attributes for Saskatchewan's grade 12 graduates.

### Lifelong Learners

In the course of learning during Practical and Applied Arts classes, students will gain a positive sense of identity and efficacy through development of practical skills and knowledge. The Practical and Applied Arts curricula are closely related to careers found in Saskatchewan and, therefore, are directly connected to lifelong learning whether in a professional career or through hobbies and personal interests.

*Related to the following Goals of Education:*

- *Basic Skills*
- *Lifelong Learning*
- *Positive Lifestyle*

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Related to the following Goals of Education:

- *Understanding and Relating to Others*
- *Self Concept Development*
- *Spiritual Development*

Related to the following Goals of Education:

- *Career and Consumer Decisions*
- *Membership in Society*
- *Growing with Change*

K-12 Goals for Developing Thinking:

- *Thinking and learning contextually*
- *Thinking and learning creatively*
- *Thinking and learning critically.*

K-12 Goals for Developing Identity and Interdependence:

- *Understanding, valuing, and caring for oneself (intellectually, emotionally, physically, spiritually)*
- *Understanding, valuing, and caring for others*
- *Understanding and valuing social, economic, and environmental interdependence and sustainability.*

## **Sense of Self, Community, and Place**

To engage in the Practical and Applied Arts, students need not only to use knowledge and skills but also to interact with each other. Through the Practical and Applied Arts, students learn about themselves, others, and the world around them. They use their new understanding and skills to explore who they are and who they might become. Practical and Applied Arts programming should vary by school to reflect the community at large. Community projects can play a key role in Practical and Applied Arts programming and connect the school more closely to the community.

## **Engaged Citizens**

Engaged citizens have empathy for those around them and contribute to the well-being of the community as a whole. Practical and Applied Arts students learn how new skills and abilities enable them to make a difference in their personal lives as well as in their family and community. Skills and abilities gained in Practical and Applied Arts classes build a sense of confidence which encourages students to participate effectively in their world.

## **Cross-curricular Competencies**

The Cross-curricular Competencies are four interrelated areas containing understandings, values, skills, and processes which are considered important for learning in all areas of study. In the Practical and Applied Arts, the Cross-curricular Competencies are also related to lifelong learning through career development and transitions to post-secondary training, education, and work.

## **Developing Thinking**

Learners construct knowledge through application of prior experiences in their lives to the new contexts. Practical and Applied Arts not only present new contexts, but present them in real world situations. For example, students will solve problems, test hypotheses, design models, and analyze products during Practical and Applied Arts classes.

## **Developing Identity and Interdependence**

Developing identity includes exploring career opportunities through the Practical and Applied Arts. As students gain in experience in various Practical and Applied Arts classes, they create a sense of efficacy to contribute not only to their own well-being but also to those around them. The Practical and Applied Arts provide effective interaction between students, but also opportunities to contribute skills and abilities to the larger community.

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## Developing Literacies

Literacies provide many ways to express a personal understanding of the world. Literacy in the world of Practical and Applied Arts can mean interpreting symbols on a welding diagram or creating a computer code for an interactive media website. The use of technology to communicate ideas and information is key to many of the Practical and Applied Arts.

## Developing Social Responsibility

Contributing positively to one's natural, social, and constructed environments underlies the knowledge and skills developed through the Practical and Applied Arts. Individual interests and talents can be nurtured through the Practical and Applied Arts and directed toward contributions to the community. Projects including teamwork, consensus building, and diversity enhance the development of social responsibility.

## Purpose and Areas of Focus for Welding

The purpose of the Welding 10, 20, A30, B30 curriculum is to have students construct knowledge and acquire skills used in the welding industry and to become familiar with careers in welding.

Areas of focus identify the key components of what students are expected to know, understand, and be able to do upon completion of the learning in the Practical and Applied arts (PAA) curriculum. Because the PAA curricula generally contain more learning than one course (1 credit), the Areas of Focus are not meant to be fully attainable after 100 hours of learning. The Areas of Focus for Welding 10, 20, A30, B30 are:

- develop understandings and skills using tools and equipment necessary in oxy-acetylene, electric arc, and gas metal arc welding (GMAW)
- provide experiences and information regarding possible career pathways including post-secondary education and training, in the welding industry
- develop communication skills and apply mathematical understanding used in the welding industry
- develop the responsibility, understanding, and skills needed to work safely in the school shop and work environment.

*K-12 Goals for Developing Literacies:*

- *Constructing knowledge related to various literacies*
- *Exploring and interpreting the world through various literacies*
- *Expressing understanding and communicating meaning using various literacies.*

*K-12 Goals for Developing Social Responsibility:*

- *Using moral reasoning processes*
- *Engaging in communitarian thinking and dialogue*
- *Taking social action.*

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## Teaching Welding

Every part of your life depends on welding from the car you drive to the building you teach in to the desk and chair in your office or classroom. The food you ate for breakfast likely could not have been planted, harvested, packaged, or transported to your store without several machines or processes dependent on welding. This basic thinking exercise emphasizes the reality of what we take for granted in our constructed world. Not very often does the average person consider the importance of welding to the clothes they wear or the television they watch.

Welding equipment is complex and expensive; therefore, careful use and maintenance are important to schools and their shops. Purchasing of metal is also an expensive proposition for schools. Shopping around can be beneficial for cost savings, but dealing consistently with a local supplier can create a good working relationship. Either way, the cost of materials remains a large undertaking for welding programs. Support is needed from both school administration and school boards to adequately support programming. The curriculum recommends standard gauges of metal used in the welding industry.

Instructors and students need to be able to identify the metal being welded. Generally, the metal ordered for the shop comes with the manufacturer's specifications; however, when repair work is being done, other methods of identifying the metal must be used. Identification of steel is most easily done through tests of colour, density, ring, and magnetism. Spark tests can also be easily done in most shops with a grinder. Any good resource on metals will explain these tests in detail.

Generally, non-ferrous metals can be identified by their colour and lack of magnetism. They are also generally fairly soft and will not spark when touched to a grinding wheel.

Sheet metal can be measured both by gauge and by numerical thickness, in either the Imperial or metric system. When measuring by gauge, the higher the number, the thinner the material. In most shops, the Imperial system is also used for thicker sheet metal. Students learn to convert between Imperial and SI systems in mathematics courses and can apply this learning when welding.

Cleanliness in the shop will help to increase the longevity of equipment and tools. Regular maintenance of machines and tools also contributes to their longevity. This is also a costly part of running a quality program and needs budget consideration. The investment pays off, however, in creating a safe and healthy environment. Good housekeeping can also reduce the number of unintentional injuries to students and teachers.

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Skills develop over time with quality instruction and practice. Students in post-secondary programs, such as the pre-employment program at SIAST, and apprentices learn and refine skills over time with practice. Many of these programs are also available through the regional colleges in the province. Skills development in welding also includes activities such as measurement and document use. Document use refers to being able to read symbols and diagrams in the welding industry.

Measurement involves calculations and computations which reinforce the relevance of skills learned in math classes. Changes of state in the metal being welded are related to the scientific principles studied in physics and chemistry.

Safety is of the utmost concern in the welding shop. Developing a safe environment includes the establishment of an inquiring and safe attitude. "If you don't know, ask!" should be the motto of the shop. Responsibility for safety in the shop rests with each individual working there, but teachers shoulder the ultimate responsibility of instituting safe work practices. Hazards in the welding shop include those from heat such as fire, burns, and flash. Welding using electrical processes requires the knowledge and respect of high voltage and current. The heavy nature of metal makes lifting and carrying properly a vital part of the education of students. Protecting sight and hearing should be a known skill before anyone enters the shop. Air quality is affected by welding processes and needs to be addressed with regard to the health of everyone in the shop.

Safe Saskatchewan exists to create an injury-free province wherever citizens live, work, or play. As the province currently has one of the highest injury rates in Canada, Safe Saskatchewan works to inform all people of their core beliefs. One of those beliefs is that all injuries are predictable and preventable. That is why users of this curriculum will not see the word accident; rather, the term "unintentional injuries" is used to describe situations where individuals are harmed both in and away from the workplace.

## Teaching for Deep Understanding

For deep understanding, it is vital that students learn by constructing knowledge, with few understandings being provided directly by the teacher. As an example, basic safety in welding is something which the teacher will have to show and name for the students; however, first, the students could explore the ideas important for working with safety in their lives outside of the school. Demonstrations by the teacher in the shop often form a significant portion of the instruction, but the students must have adequate practice time to construct their own understandings of the feel of adequately demonstrating the required skill.

*What types of things might you hear or see in a Welding class that would indicate to you that students were developing a deep understanding?*

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*Inquiry is a philosophical stance rather than a set of strategies, activities, or a particular teaching method. As such, inquiry promotes intentional and thoughtful learning for teachers and children.*

*(Mills & Donnelly, 2001, p. xviii)*

It is important for teachers to analyze the outcome in each module to identify what students need to know, understand, and be able to do. Teachers also need to consider opportunities for students to explain, apply, and transfer understanding to new situations. This reflection supports professional decision making and planning effective strategies to promote students' deeper understanding of ideas.

Practical and Applied Arts skills and understandings are learned when students engage in deliberate activities planned with key concepts of the subject area. When students participate in classes where they are only told what to do, how to do it, and when to do it, they cannot make the strong connections necessary for learning to be meaningful, easily accessible, and transferable. The learning environment must be respectful of individuals and groups, fostering discussion and self-reflection, the asking of questions, the seeking of multiple answers, the opportunity for application, and the construction of meaning.

## **Inquiry**

Inquiry learning provides students with opportunities to build knowledge, abilities, and inquiring habits of mind that lead to deeper understanding of their world and human experience. The inquiry process focuses on the development of compelling questions, formulated by teachers and students, to motivate and guide inquiries into topics, problems, and issues related to curriculum content and outcomes. Inquiry is more than a simple instructional method. It is a philosophical approach to teaching and learning, grounded in constructivist research and methods, which engages students in investigations that lead to understanding and skills within the discipline as well as knowledge that is applicable across disciplines. For example, understanding the science of molten metal in welding will support understanding of states of matter in science.

Inquiry builds on students' inherent sense of curiosity and wonder, drawing on their diverse backgrounds, interests, and experiences. The process provides opportunities for students to become active participants in a collaborative search for meaning and understanding. Students who are engaged in inquiry:

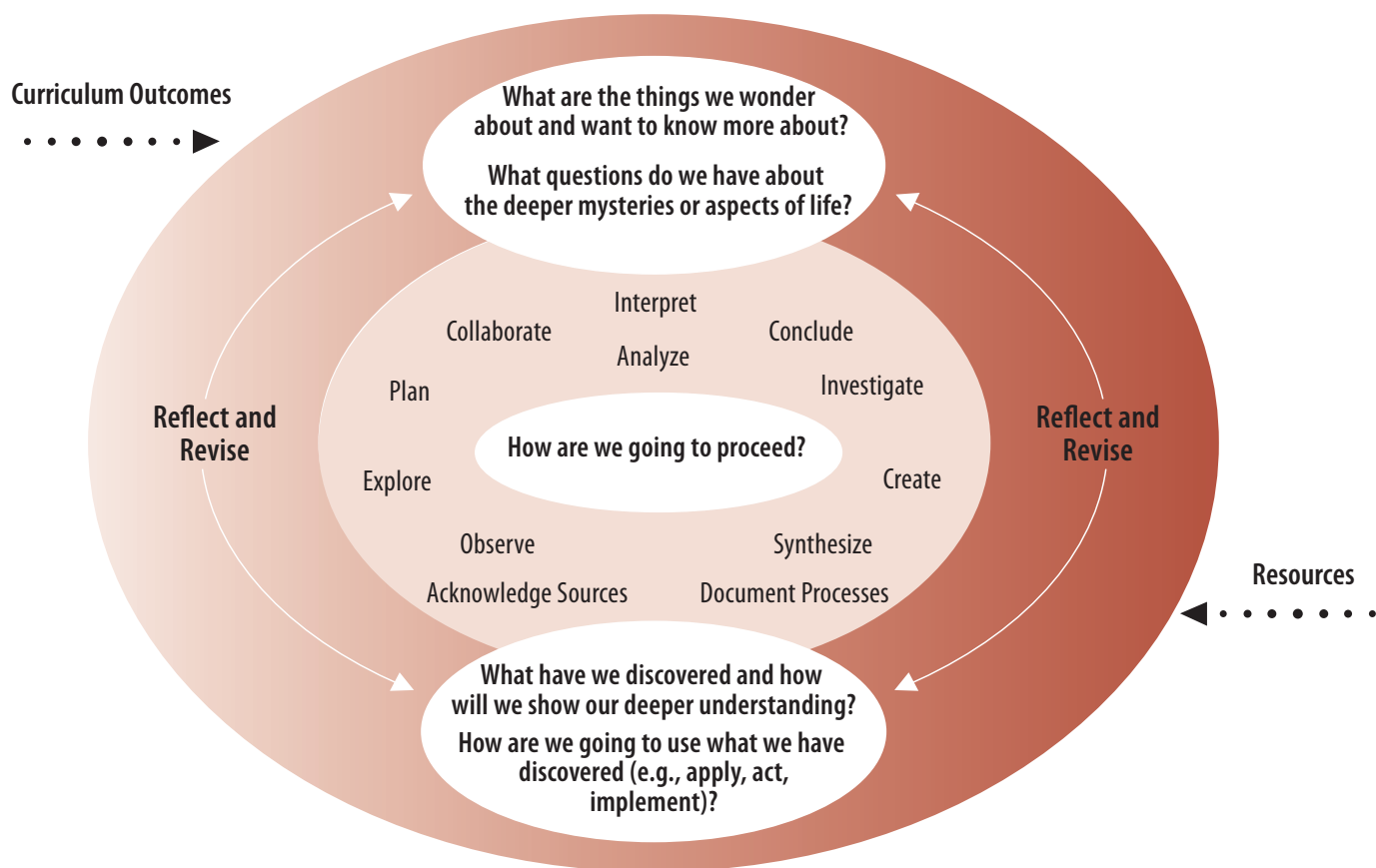
- construct deep knowledge and deep understanding rather than passively receiving it
- are directly involved and engaged in the discovery of new knowledge
- encounter alternative perspectives and conflicting ideas that transform prior knowledge and experience into deep understanding

- transfer new knowledge and skills to new circumstances (e.g., the workplace)
- take ownership and responsibility for their ongoing learning of curriculum content and skills.

(Adapted from Kuhlthau & Todd, 2008, p. 1)

Inquiry learning is not a step-by-step process, but rather a cyclical process, with parts of the process being revisited and rethought as a result of students' discoveries, insights, and construction of new knowledge. The following graphic shows the cyclical inquiry process.

### Constructing Understanding Through Inquiry



Inquiry prompts and motivates students to investigate topics within meaningful contexts. The inquiry process is not linear or lock-step, but is flexible and recursive. Experienced inquirers move back and forth through the cyclical process as new questions arise and as students become more comfortable with the process.

*Effective questions:*

- *cause genuine and relevant inquiry into the important ideas and core content*
- *provide for thoughtful, lively discussion, sustained inquiry, and new understanding as well as more questions*
- *require students to consider alternatives, weigh evidence, support their ideas, and justify their answers*
- *stimulate vital, ongoing rethinking of key ideas, assumptions, and prior lessons*
- *spark meaningful connections with prior learning and personal experiences*
- *naturally recur, creating opportunities for transfer to other situations and subjects.*

*(Wiggins & McTighe, 2005, p. 110)*

Well-formulated inquiry questions are broad in scope and rich in possibilities. They encourage students to explore, gather information, plan, analyze, interpret, synthesize, problem solve, take risks, create, develop conclusions, document, and reflect on learning, and develop new questions for further inquiry.

In Practical and Applied Arts, inquiry encompasses creating solutions to challenges through practical application of understandings and skills. This includes processes to get from what is known to discover what is unknown. When teachers show students how to solve a challenge and then assign additional challenges that are similar, the students are not constructing new knowledge through application, but merely practising. Both are necessary elements of skill building in Practical and Applied Arts, but one should not be confused with the other. If the path for getting to the end situation has already been determined, it is no longer problem solving. Students must understand this difference as well.

### **Creating Questions for Inquiry in Practical and Applied Arts**

Teachers and students can begin their inquiry at one or more entry points; however, the process may evolve into learning opportunities across disciplines, as reflective of the holistic nature of our lives. It is essential to develop questions evoked by students' interests and that have potential for rich and deep learning. Compelling questions are used to initiate and guide the inquiry, and give students direction for discovering deep understandings about a topic or issue under study.

The process of constructing inquiry questions can help students to grasp the important disciplinary ideas situated at the core of a particular curricular focus or context. These broad questions will lead to more specific questions that can provide a framework, purpose, and direction for the learning activities in a lesson or project, and help students connect what they are learning to their experiences and life beyond school.

Effective questions in Practical and Applied Arts are the key to initiating and guiding students' investigations, critical thinking, problem solving, and reflection on their own learning. Questions such as:

- What is the best solution to creating a strong welding joint in this circumstance and for this purpose?
- Which elements of design will produce the desired effect in clothing creation?
- Which visual effects will be most effective in engaging my audience on a website?



- 
- What community needs can be met by applying my skills in horticulture?

The above are only a few examples of questions to move students' inquiry towards deeper understanding. Effective questioning is essential for teaching and student learning, and should be an integral part of planning. Questioning should also be used to encourage students to reflect on the inquiry process and on the documentation and assessment of their own learning.

Questions should invite students to explore concepts within a variety of contexts and for a variety of purposes. When questioning students, teachers should choose questions that:

- encourage students to make use of the knowledge and skills of the discipline.
- are open-ended, whether in answer or approach, and there may be multiple answers or multiple approaches
- empower students to explore their curiosity and unravel their misconceptions
- not only require the application of skills but encourage students to make connections and are applicable to new situations
- lead students to wonder more about a topic and to perhaps construct new questions themselves as they investigate this newly found interest.

(Adapted from Schuster & Canavan Anderson, 2005, p. 3)

## **Reflection and Documentation of Inquiry**

An important part of any inquiry process is student reflection on their learning and the documentation needed to assess the learning and make it visible. Student documentation of the inquiry process in welding may take the form of reflective journals, notes, drafts, models, projects, photographs, or video footage. This documentation should illustrate the students' strategies and thinking processes that led to new insights and conclusions. Inquiry-based documentation can be a source of rich assessment materials through which teachers can gain a more in-depth look into their students' understandings. These types of documentation can be utilized in any Practical and Applied Arts course.

It is important students engage in the communication and representation of their progress in building skills and understandings. A wide variety of forms of communication and representation should be encouraged and, most importantly, have links made between them. In this way, student inquiry can develop and strengthen student understanding through self reflection.

## Module Overview Chart

Module Code	Modules	Suggested Time (hrs)
WLDG01	Module 1: General Shop Safety (Core)	2-3
WLDG02	Module 2: Intermediate Safety (Core)	1-2
WLDG03	Module 3: Hand and Power Tools (Core)	3-15
WLDG04	Module 4: Intermediate Hand and Power Tools (Core)	1-2
WLDG05	Module 5: Oxy-acetylene Start-up, Shut-down, and Cutting (Core)	3-5
WLDG06	Module 6: Introduction to Oxy-acetylene Cutting (Core)	3-5
WLDG07A	Module 7A: Oxy-acetylene Cutting Skills (Core)	5-7
WLDG07B	Module 7B: Oxy-acetylene Cutting Skills (Core)	3-5
WLDG08	Module 8: Oxy-acetylene Cutting Practice (Core)	5-7
WLDG09	Module 9: Oxy-acetylene Welding (Core)	5-6
WLDG10	Module 10: Intermediate Oxy-acetylene Welding (Core)	1-2
WLDG11A	Module 11A: Oxy-acetylene Welding Practice (Core)	10-12
WLDG11B	Module 11B: Oxy-acetylene Welding Practice (Core)	20-25
WLDG12A	Module 12A: Advanced Oxy-acetylene Welding Projects (Optional)	5-10
WLDG12B	Module 12B: Advanced Oxy-acetylene Welding Projects (Optional)	5-10
WLDG13	Module 13: Plasma Arc Cutting (Core)	1-2
WLDG14	Module 14: Shielded Metal Arc Welding Procedures and Equipment (Core)	3-4
WLDG15	Module 15: Electric Arc Welding: Welding Faults (Core)	1-2
WLDG16	Module 16: Electric Arc Welding (Core)	1-2
WLDG17	Module 17: Electric Arc Welding Electrodes (Core)	1-2
WLDG18	Module 18: Electric Arc Welding Skill Development – 7014, 7024, 7018, and 6010 (Core)	5-7
WLDG19	Module 19: Electric Arc Welding Skill Development – Padding and Butt Weld (Core)	15-20
WLDG20A	Module 20A: Electric Arc Welding Skills (Core)	25-30
WLDG20B	Module 20B: Electric Arc Welding Skills (Core)	30-35
WLDG20C	Module 20C: Electric Arc Welding Skills (Core)	35-40
WLDG21A	Module 21A: Introductory Project (Optional)	15-20
WLDG21B	Module 21B: Intermediate Project (Optional)	5-10
WLDG21C	Module 21C: Advanced Project (Optional)	5-10
WLDG22	Module 22: The Nature and Production of Iron and Steel (Core)	2-5
WLDG23	Module 23: Soldering (Optional)	2-3
WLDG24	Module 24: Brazing (Optional)	5-10
WLDG25A	Module 25A: Gas Metal Arc Welding (GMAW) Safety and Equipment (Core)	2-3
WLDG 25B	Module 25B: GMAW Safety and Equipment (Core)	1-2
WLDG 25C	Module 25C: GMAW Safety and Equipment (Core)	1-2
WLDG 25D	Module 25D: GMAW Safety and Equipment (Core)	1-2

WLDG26	Module 26: GMAW Care and Maintenance Requirements (Core)	1-2
WLDG27A	Module 27A: GMAW Procedures and Practice (Core)	15-20
WLDG27B	Module 27B: GMAW Procedures and Practice (Core)	7-10
WLDG27C	Module 27C: GMAW Procedures and Practice (Core)	15-20
WLDG27D	Module 27D: GMAW Procedures and Practice (Core)	15-20
WLDG28A	Module 28A: GMAW Projects (Optional)	5-10
WLDG28B	Module 28B: GMAW Projects (Optional)	5-10
WLDG29	Module 29: Personal Skills for Success (Optional)	1-2
WLDG30	Module 30: Employability Skills and Workplace Expectations (Optional)	1-2
WLDG31A	Module 31A: Work Study Preparation (Optional)	3-5
WLDG31B	Module 31B: Work Study Preparation (Optional)	3-5
WLDG31C	Module 31C: Work Study Preparation (Optional)	3-5
WLDG32A	Module 32A: Work Study Placement (Optional)	25-50
WLDG32B	Module 32B: Work Study Placement (Optional)	25-50
WLDG32C	Module 32C: Work Study Placement (Optional)	25-50
WLDG 33A	Module 33A: Work Study Follow-up (Optional)	2-4
WLDG 33B	Module 33B: Work Study Follow-up (Optional)	2-4
WLDG 33C	Module 33C: Work Study Follow-up (Optional)	2-4
WLDG34	Module 34: Careers in Welding (Core)	2-5
WLDG88	Module 88: Apprenticeship in Saskatchewan (Optional)	3-5
WLDG99A	Module 99A: Extended Study (Optional)	10-25
WLDG99B	Module 99B: Extended Study (Optional)	10-25
WLDG99C	Module 99C: Extended Study (Optional)	10-25
WLDG99D	Module 99D: Extended Study (Optional)	10-25

**Note:** When recording modules from this curriculum in the Module Recordkeeping section of the Student Data System (SDS), please be sure to use the modules with the prefix WLDG. Modules for the previous curriculum continue to be in the SDS with the prefix WELD in order to maintain the integrity of the data for students who completed modules from that curriculum.

## Suggested Course Configurations

Module Code	Modules	Suggested Time (hrs)
	<b>Welding 10</b>	
WLDG01	Module 1: General Shop Safety (Core)	2-3
WLDG03	Module 3: Hand and Power Tools (Core)	3-15
WLDG05	Module 5: Oxy-acetylene Start-up, Shut-down, and Cutting (Core)	3-5
WLDG06	Module 6: Introduction to Oxy-acetylene Cutting (Core)	3-5
WLDG09	Module 9: Oxy-acetylene Welding (Core)	5-6
WLDG11A	Module 11A: Oxy-acetylene Welding Practice (Core)	10-12
WLDG14	Module 14: Shielded Metal Arc Welding Procedures and Equipment (Core)	3-4
WLDG15	Module 15: Electric Arc Welding: Welding Faults (Core)	1-2
WLDG16	Module 16: Electric Arc Welding (Core)	1-2
WLDG17	Module 17: Electric Arc Welding Electrodes (Core)	1-2
WLDG18	Module 18: Electric Arc Welding Skill Development – 7014, 7024, 7018, and 6010 (Core)	5-7
WLDG19	Module 19: Electric Arc Welding Skill Development – Padding and Butt Weld (Core)	15-20
WLDG25A	Module 25A: GMAW Safety and Equipment (Core)	2-3
WLDG27A	Module 27A: GMAW Procedures and Practice (Core)	15-20
WLDG34	Module 34: Careers in Welding (Core)	2-5
WLDG99A	Module 99A: Extended Study (Optional)	10-25
	<b>Minimum</b>	<b>100</b>
	<b>Welding 20</b>	
WLDG02	Module 2: Intermediate Safety (Core)	1-2
WLDG04	Module 4: Intermediate Hand and Power Tools (Core)	1-2
WLDG07A	Module 7A: Oxy-acetylene Cutting Skills (Core)	5-7
WLDG10	Module 10: Intermediate Oxy-acetylene Welding (Core)	1-2
WLDG11B	Module 11B: Oxy-acetylene Welding Practice (Core)	20-25
WLDG13	Module 13: Plasma Arc Cutting (Core)	1-2
WLDG20A	Module 20A: Electric Arc Welding Skills (Core)	25-30
WLDG21A	Module 21A: Introductory Project (Optional)	15-20
WLDG25B	Module 25B: GMAW Safety and Equipment (Core)	1-2
WLDG27B	Module 26: GMAW Care and Maintenance Requirements (Core)	1-2
WLDG 26	Module 27B: GMAW Welding Procedures and Practice (Core)	7-10
WLDG31A	Module 31A: Work Study Preparation (Optional)	3-5
WLDG32A	Module 32A: Work Study Placement (Optional)	25-50
WLDG33A	Module 33A: Work Study Follow-up (Optional)	2-4
WLDG99B	Module 99B: Extended Study (Optional)	10-25
	<b>Minimum</b>	<b>100</b>

	<b>Welding A30</b>	Suggested Time (hrs)
WLDG7B	Module 7B: Oxy-acetylene Cutting Skills (Core)	3-5
WLDG12A	Module 12A: Advanced Oxy-acetylene Welding Projects (Optional)	5-10
WLDG20B	Module 20B: Electric Arc Welding Skills (Core)	30-35
WLDG21B	Module 21B: Intermediate Project (Optional)	5-10
WLDG22	Module 22: The Nature and Production of Iron and Steel (Core)	2-5
WLDG25C	Module 25C: GMAW Safety and Equipment (Core)	1-2
WLDG27C	Module 27C: GMAW Procedures and Practice (Core)	15-20
WLDG28A	Module 28A: GMAW Projects (Optional)	5-10
WLDG29	Module 29: Personal Skills for Success (Optional)	1-2
WLDG30	Module 30: Employability Skills and Workplace Expectations (Optional)	1-2
WLDG31B	Module 31B: Work Study Preparation (Optional)	3-5
WLDG32B	Module 32B: Work Study Placement (Optional)	25-50
WLDG33B	Module 33B: Work Study Follow-up (Optional)	2-4
WLDG88	Module 88: Apprenticeship in Saskatchewan (Optional)	3-5
WLDG99C	Module 99C: Extended Study (Optional)	10-25
	<b>Minimum</b>	<b>100</b>
	<b>Welding B30</b>	
WLDG08	Module 8: Oxy-acetylene Cutting Practice (Core)	5-7
WLDG12B	Module 12B: Advanced Oxy-acetylene Welding Projects (Optional)	5-10
WLDG20C	Module 20C: Electric Arc Welding Skills (Core)	35-40
WLDG21C	Module 21C: Advanced Project (Optional)	5-10
WLDG23	Module 23: Soldering (Optional)	2-3
WLDG24	Module 24: Brazing (Optional)	5-10
WLDG25D	Module 25D: GMAW Safety and Equipment (Core)	1-2
WLDG27D	Module 27D: GMAW Procedures and Practice (Core)	15-20
WLDG28B	Module 28B: GMAW Projects (Optional)	5-10
WLDG31C	Module 31C: Work Study Preparation (Optional)	3-5
WLDG32C	Module 32C: Work Study Placement (Optional)	25-50
WLDG33C	Module 33C: Work Study Follow-up (Optional)	2-4
WLDG 99D	Module 99D: Extended Study (Optional)	10-25
	<b>Minimum</b>	<b>100</b>

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## Outcomes and Indicators

### Module 1: General Shop Safety (Core)

Suggested Time: 2-3 hours

Level: Introductory

Prerequisite: None

#### Outcome

Apply principles and techniques for unintentional injury prevention to ensure safe work performance in the welding area.

#### Indicators

- a. Identify the purpose and demonstrate the proper use and fit of personal protective equipment (PPE) including eye protection (lens shades), clothing, hearing protection, and footwear while identifying the hazards from which they protect individuals.
- b. Analyze potential risk situations and solutions that apply specifically to slips and falls, as well as lifting heavy material, and identify safe solutions.
- c. Recognize hazards associated with oxy-acetylene welding equipment (i.e., tanks, hoses, gauges) and take the necessary measures to avoid unintentional injuries, including those caused by flashback and backfire.
- d. Recognize hazards associated with electric welding processes and take necessary measures to avoid unintentional injuries.
- e. Evaluate the fire plan for the shop, including components such as fire alarms, fire extinguishers, exits, and procedures; and make recommendations for improvements.
- f. Demonstrate the proper procedures to follow when reporting an unintentional injury.

### Module 2: Intermediate Safety (Core)

Suggested Time: 1-2 hours

Level: Introductory

Prerequisite: Module 1

#### Outcome

Work safely with properly maintained safety equipment in an organized environment.

#### Indicators

- a. Express knowledge of safe handling of materials according to WHMIS, using materials safety data sheets (MSDS).
- b. Research and discuss Occupational Health and Safety regulations which apply to the welding industry.
- c. Recognize and apply safe and fair work practices including freedom from violence and harassment.
- d. Complete an assessment of all safety and welding equipment and, in consultation with the instructor, perform maintenance to repair or replace defective or worn parts.

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### Module 3: Hand and Power Tools (Core)

**Suggested Time:** 3-15 hours

**Level:** Introductory

**Prerequisite:** None

**Outcome**

**Indicators**

Demonstrate and explain the correct procedures for the safe use, care, and handling of the hand tools and power equipment used in a welding shop.

- a. Identify and define the safe use of hand tools such as hammers, pliers, wire brushes, strikers, anvils, files, tip cleaners, hand shears, hacksaws, clamps, vices, and marking tools.
- b. Demonstrate and articulate the correct procedures for operating power tools such as grinders (stationary and portable), buffers (stationary and portable), power shear, power hacksaw, band saw, and drill press.

### Module 4: Intermediate Hand and Power Tools (Core)

**Suggested Time:** 1-2 hours

**Level:** Intermediate

**Prerequisite:** Module 3

**Outcome**

**Indicators**

Assess the condition of and the maintenance of tools used in the welding shop.

- a. Demonstrate the proper method for cleaning weld-spattered tools.
- b. Assess and report any potential faults with electrical cords and receptacles.
- c. Repair or replace welding-distorted surfaces on benches or table tops in consultation with the instructor.
- d. Demonstrate the proper techniques to remove and replace saw blades.
- e. Identify potential maintenance issues with hand and power tools and consult with the instructor to determine a solution.

### Module 5: Oxy-acetylene Start-up, Shut-down, and Cutting (Core)

**Suggested Time:** 3-5 hours

**Level:** Introductory

**Prerequisite:** None

**Outcome**

**Indicators**

Develop and apply a systematic routine for setting up and putting away oxy-acetylene equipment.

- a. Describe and perform the accepted start-up and shut-down procedures for the oxy-acetylene system which includes valves, regulators, torches, tips, types of flames, and safety precautions.
- b. Understand and describe how to cut  $\frac{3}{8}$ " mild steel including the correct flame, flame distance, angle of the tip, direction of travel, speed of travel, and motion of tip.

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### Module 6: Introduction to Oxy-acetylene Cutting (Core)

Suggested Time: 3-5 hours

Level: Intermediate

Prerequisite: Module 5

#### Outcome

Demonstrate safe and effective cutting using an oxy-acetylene torch after determining the proper tip size and gas pressure for the gauge of metal.

#### Indicators

- a. Identify precautionary procedures to limit the danger to others in the shop.
- b. Describe the relationship between the tip size, metal thickness, and gas pressures.
- c. Demonstrate the specified cuts on the provided material using an oxy-acetylene cutting torch.

### Module 7A: Oxy-acetylene Cutting Skills (Core)

Suggested Time: 5-7 hours

Level: Intermediate

Prerequisite: Module 6

#### Outcome

Demonstrate use of an oxy-acetylene torch to make specified cuts.

#### Indicators

- a. Cut straight lines on  $\frac{3}{8}$ " mild steel.
- b. Complete bevel cuts on  $\frac{3}{8}$ " mild steel.
- c. Cut holes and circles on  $\frac{3}{8}$ " mild steel.

### Module 7B: Oxy-acetylene Cutting Skills (Core)

Suggested Time: 3-5 hours

Level: Advanced

Prerequisites: Modules 6 and 7A

#### Outcome

Demonstrate cuts to fit a given template to increase accuracy to within  $\frac{1}{16}$ " tolerance.

#### Indicators

- a. Complete round and/or curved cuts specified by the instructor.
- b. Complete square and/or rectangular cuts specified by the instructor.

### Module 8: Oxy-acetylene Cutting Practice (Core)

Suggested Time: 5-7 hours

Level: Intermediate

Prerequisite: Module 7B

#### Outcome

Demonstrate cutting with an oxy-acetylene torch on a variety of metal thicknesses to achieve a high quality cut.

#### Indicators

- a. Demonstrate the correct settings for the oxygen and the acetylene regulators and explain the relationship between the settings and the metal thickness.
- b. Demonstrate and evaluate oxy-acetylene cutting torch work on a variety of thicknesses and types of metal.



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### Module 9: Oxy-acetylene Welding (Core)

Suggested Time: 5-6 hours

Level: Introductory

Prerequisite: Module 5

#### Outcome

Use oxy-acetylene equipment to complete the specified welds and analyze the results.

#### Indicators

- a. Run lines of fusion without the use of filler rod in the flat position on gauge mild steel.
- b. Assess the quality of personal work on practical assignments including butt weld, edge weld, and lines of fusion.

### Module 10: Intermediate Oxy-acetylene Welding (Core)

Suggested Time: 1-2 hours

Level: Intermediate

Prerequisite: Module 9

#### Outcome

Effectively use oxy-acetylene equipment to increase the quality of the specified welds.

#### Indicators

- a. Perform and analyze a variety of specified welds, including butt weld, edge weld, and lines of fusion.
- b. Compare and chart personal progress to identify increasing skill.
- c. Assess personal technique and document results in consultation with the instructor.

### Module 11A: Oxy-acetylene Welding Practice (Core)

Suggested Time: 10-12 hours

Level: Intermediate

Prerequisite: Module 10

#### Outcome

Demonstrate an increasingly high quality of both welding skill and self-assessment of that skill while using oxy-acetylene equipment.

#### Indicators

- a. Create examples of basic oxy-acetylene welding practices, including beads with no filler, edge weld, corner weld, beads with filler, butt weld, and lap weld.
- b. Perform an outside corner weld, no filler rod, in the flat position, on gauge mild steel.
- c. Run lines of fusion using filler rod, in the flat position, on gauge mild steel.
- d. Perform a butt weld using filler rod, in the flat position, on gauge mild steel.
- e. Assess personal technique and results in consultation with the instructor.

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### Module 11B: Oxy-acetylene Welding Practice (Core)

**Suggested Time:** 20-25 hours

**Level:** Intermediate

**Prerequisite:** Module 10

#### Outcome

**Demonstrate increasing proficiency in oxy-acetylene welding skills.**

#### Indicators

- a. Perform a butt weld using filler rod, in the flat position, on gauge mild steel ensuring 100% penetration.
- b. Perform a butt weld using filler rod, in the vertical position, on gauge mild steel.
- c. Perform a lap weld using filler rod, in the flat position, on gauge mild steel; overlap by half.
- d. Assess personal technique and document results in consultation with the instructor.

### Module 12A: Advanced Oxy-acetylene Welding Projects (Optional)

**Suggested Time:** 5-10 hours

**Level:** Advanced

**Prerequisite:** Module 11A

#### Outcome

**Select, complete, and assess an approved oxy-acetylene welding project to demonstrate welding proficiency.**

#### Indicators

- a. Create a drawing and develop a cutting list of materials.
- b. Use organized and practised skills to construct a project using appropriate technical language. Utilize the following guidelines to complete a project:
  - Generate different project ideas
  - Plan and manage the project including assessment criteria in consultation with the instructor
  - Plan and use drawings with appropriate symbols
  - Set a procedural sequence
  - Prepare a material list and cost estimate
  - Create a timeline
  - Determine fabrication techniques
  - Cut material and set up in the proper sequence
  - Complete each part as specified
  - Interpret and follow directions
  - Adhere to timelines
  - Work cooperatively
  - Follow all safety requirements
  - Follow all handling and storing procedures
  - Fulfill cleanup and tool maintenance responsibilities
  - Present the completed project and complete a self-assessment based on the criteria for the project.

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### Module 12B: Advanced Oxy-acetylene Welding Projects (Optional)

**Suggested Time:** 5-10 hours

**Level:** Advanced

**Prerequisite:** Module 11B

#### Outcome

Plan, complete, and assess an oxy-acetylene welding project to demonstrate increasing welding proficiency.

#### Indicators

- a. Create a scale drawing of the project using appropriate symbols including a cutting list.
- b. Calculate the cost of material including incidentals.
- c. Demonstrate increasing development of welding skills.
- d. Develop a project plan to include major stages of development and a timeline needed for completion as outlined in module 12A.

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### Module 13: Plasma Arc Cutting (Core)

**Suggested Time:** 1-2 hours

**Level:** Intermediate

**Prerequisite:** None

#### Outcome

Effectively use plasma arc cutting equipment to cut metal of various thicknesses and types.

#### Indicators

- a. Identify and describe safety considerations for appropriate use of plasma arc cutting equipment.
- b. Correctly use plasma arc cutting equipment to perform various cuts specified by the instructor.
- c. Verify the correct pressure settings and techniques to safely cut ferrous and non-ferrous metals of given thicknesses.

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### Module 14: Shielded Metal Arc Welding Procedures and Equipment (Core)

**Suggested Time:** 3-4 hours

**Level:** Introductory

**Prerequisite:** None

#### Outcome

Demonstrate a knowledge of and expertise with electric arc welding equipment including common types of electrodes, currents, and welding positions while using the correct terminology.

#### Indicators

- a. Define and appropriately use terminology related to electric arc welding including alternating current, ampere, anode, arc, backing or backup, backhand welding, backstep welding, base metal, bead, bevel, brazing, capillary attraction, cathode, chipping, circuit, complete penetration, contraction, constant current, cover glass, crater, direct current, distortion, downhand welding, ductility, duty cycle, elasticity, electrode circuit, expansion, ferrous, finished bead, finished surface, flux, forehand welding, fusion welding, gaseous shield, generator, kerf, non-ferrous, parent metal, peening, penetration, polarity, porosity, rectifier, root opening, slag, solder, spatter, strain, stress, tensile strength, transformer, uphand welding, voltage, warping, yield point, and yield strength.
- b. Describe the differences in welding electrodes such as 6011, 6013, 7014, and 7018.

Outcome	Indicators
Module 14 continued	<ul style="list-style-type: none"> <li>c. Categorize and explain the uses of direct current with straight and reverse polarity.</li> <li>d. Categorize and explain the difference between alternating current and direct current with straight and reverse polarity.</li> <li>e. Demonstrate start-up and shut-down procedures as well as striking the arc, setting and adjusting amperage, correct electrode angle, and appropriate rate of travel.</li> <li>f. Compile a list of specialty electrodes including those used for stainless steel, aluminium, nickel, and hard surfacing.</li> <li>g. Identify situations where flat, horizontal, vertical, and overhead positions would be used.</li> </ul>

### Module 15: Electric Arc Welding: Welding Faults (Core)

Suggested Time: 1-2 hours

Level: Introductory

Prerequisite: None

#### Outcome

#### Indicators

Identify, diagnose, and provide remedies for common arc welding faults.

- a. Identify faults such as crater-cracking, gas pockets, porosity, and undercutting.
- b. Justify and demonstrate corrections for electric arc faults.

### Module 16: Electric Arc Welding (Core)

Suggested Time: 1-2 hours

Level: Introductory

Prerequisite: None

#### Outcome

#### Indicators

Demonstrate the proper techniques for striking an arc and running a bead using four types of welds in flat and horizontal positions.

- a. Compose a list of uses for common welds including butt, flat, corner, and fillet.
- b. Run continuous weld beads on mild steel.
- c. Demonstrate basic welding practices such as striking the arc, electrode angle, rate of travel, amperage settings, and electrode selection.

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### Module 17: Electric Arc Welding Electrodes (Core)

Suggested Time: 1-2 hours

Level: Introductory

Prerequisite: None

#### Outcome

Describe critical aspects of electric arc welding such as types, uses, and characteristics of electrodes, types of current, polarity, joints, and welding positions.

#### Indicators

- a. Explain the significance of each position in the classification number for welding electrodes.
- b. Categorize the following electrodes according to uses and weld characteristics such as penetration, slag, spatter, and application: 6010, 6011, 6013, 7014, 7018, and 7024.

### Module 18: Electric Arc Welding Skill Development - 7014, 7024, 7018, and 6010 (Core)

Suggested Time: 5-7 hours

Level: Introductory

Prerequisites: Modules 16 and 17

#### Outcome

Demonstrate increasing skill in running a continuous bead using arc welding equipment.

#### Indicators

- a. Run individual beads using 7014, 6010, 7024, and 7018 electrodes.
- b. Examine weld faults and identify causes and solutions.

### Module 19: Electric Arc Welding Skill Development - Padding and Butt Weld (Core)

Suggested Time: 15-20 hours

Level: Introductory

Prerequisite: Module 18

#### Outcome

Demonstrate increasing skill in running a continuous bead using arc welding equipment with 7014, 7024, 7018, and 6010 electrodes.

#### Indicators

- a. Perform a butt weld on mild steel using the four different electrodes while demonstrating the correct arc length, electrode angle, rate of travel, and amperage setting.
- b. Demonstrate an ability to diagnose weld faults and causes.
- c. Pad a plate with at least two layers on each side.
- d. Compare and chart personal progress to identify increasing skill.
- e. Assess personal technique and results in consultation with the instructor.

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### Module 20A: Electric Arc Welding Skills (Core)

Suggested Time: 25-30 hours

Level: Intermediate

Prerequisite: Module 19

#### Outcome

Perform intermediate arc welding skills with increasing competency.

#### Indicators

- Perform a lap weld on ¼" mild steel using 7014, 7018, and 6010 electrodes.
- Perform an outside corner weld (horizontal and vertical fillet on ¼" mild steel) using 7018 electrode.
- Perform horizontal fillets (¼" and ⅜" multi-pass on ¼" mild steel) using 7014, 7018, and 7024 electrodes.
- Perform a butt weld flat (single pass; 6010 electrode; 75% penetration on ¼" mild steel).
- Perform a ⅜" vee butt flat (introductory only; 6010 root, 7018 fill and cap).
- Compare and chart personal progress to identify increasing skill.
- Assess personal technique and results in consultation with the instructor.

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### Module 20B: Electric Arc Welding Skills (Core)

Suggested Time: 30-35 hours

Level: Intermediate

Prerequisite: Module 20A

#### Outcome

**Note:** All tacks on vee butts are allowed to be ground and feathered prior to root installation.

**Note:** All root passes are allowed to be ground prior to fill and cap.

Perform intermediate arc welding skills with increasing competency.

#### Indicators

- Perform a square butt weld (6010; weld root side, flip and weld face side) capable of successfully passing a bend test.
- Perform a ⅜" vee butt flat (6010 root, 7018 fill and cap) capable of successfully passing a bend test on root and face.
- Perform a ⅜" vee butt vertical (6010 root, 7018 fill and cap) capable of successfully passing a bend test on root and face.
- Perform a horizontal fillet 10 pass (7018, 7014, or 7024; 10" coupon on ¼" mild steel).
- Safely perform bend tests on a variety of welds.
- Compare and chart personal progress to identify increasing skill.
- Assess personal technique and results in consultation with the instructor.

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## Module 20C: Electric Arc Welding Skills (Core)

Suggested Time: 35-40 hours

Level: Advanced

Prerequisite: Module 20B

### Outcome

### Indicators

**Note:** All tacks on vee butts are allowed to be ground and feathered prior to root installation.

**Note:** All root passes are allowed to be ground prior to fill and cap.

**Note:** Welds in this module may also include specific job-related welds if student will transition directly to a workplace.

**Perform the required advanced welds capable of passing a bend test to demonstrate arc welding skills with increasing accuracy.**

- a. Perform a vertical uphand fillet on ¼" mild steel (fillet sizes ¼", ⅜" and ½"; 7018).
- b. Perform a ⅜" vee butt flat (6010 root, 7018 fill and cap).
- c. Perform a ⅜" butt vertical uphand (6010 root, 7018 fill and cap).
- d. Perform a ⅜" vee butt horizontal (6010 root, 7018 fill and cap) capable of successfully passing a bend test on root and face.
- e. Compare and chart personal progress to identify increasing skill.
- f. Assess personal technique and results in consultation with the instructor.

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## Module 21A: Introductory Project (Optional)

Suggested Time: 15-20 hours

Level: Introductory

Prerequisite: Module 19

### Outcome

### Indicators

**Construct an introductory assigned or approved arc welding project.**

- a. Utilize the following guidelines to complete a project:
  - Generate different project ideas
  - Plan and manage the project including assessment criteria in consultation with the instructor.
  - Plan and use drawings with appropriate symbols
  - Set a procedural sequence
  - Prepare a material list and cost estimate
  - Create a timeline
  - Determine fabrication techniques
  - Cut material and set up in the proper sequence
  - Complete each part as specified
  - Interpret and follow directions
  - Adhere to timelines
  - Work cooperatively
  - Follow all safety requirements
  - Follow all handling and storing procedures
  - Fulfill cleanup and tool maintenance responsibilities
  - Present the completed project and complete a self-assessment based on the criteria for the project.

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### Module 21B: Intermediate Project (Optional)

Suggested Time: 5-10 hours

Level: Intermediate

Prerequisite: Module 20A

#### Outcome

Complete an intermediate approved project with a self-assessment of the specified skills.

#### Indicators

- a. Assemble and present a project utilizing skills in planning and management as outlined in Module 21A.
- b. Demonstrate increasingly proficient fabrication techniques, work skills, and presentation skills.

### Module 21C: Advanced Project (Optional)

Suggested Time: 5-10 hours

Level: Advanced

Prerequisite: Module 20B

#### Outcome

Complete and present an advanced project with a self-assessment.

#### Indicators

- a. Construct an advanced project to display the advancement of skills from previous projects.
- b. Demonstrate a proficient knowledge of welding by including a written self-assessment.

### Module 22: The Nature and Production of Iron and Steel (Core)

Suggested Time: 2-5 hours

Level: Intermediate

Prerequisite: None

#### Outcome

Develop and articulate an understanding of the materials and processes used to turn raw materials into commercially useful ferrous compounds.

#### Indicators

- a. Compare and contrast the production of pig iron, cast iron, wrought iron, and steel.
- b. Summarize the differences between the following furnace types: Bessemer, open hearth, electric, and blast.
- c. Accurately use steel production terminology including hot rolled, cold rolled, cast steels, ferrous metals, non-ferrous metals, and metallurgy.
- d. Examine the differences between high and low carbon steels.
- e. Describe the effects and implications of expansion and contraction of metal.



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### Module 23: Soldering (Optional)

**Suggested Time:** 2-3 hours

**Level:** Intermediate

**Prerequisite:** None

**Outcome**

Demonstrate and explain the soldering process including how it is scientifically different from welding.

**Indicators**

- a. Investigate and articulate the differences between welding and soldering.
- b. Explain and demonstrate the lead alloy soldering process including material preparation and the use of flux.
- c. Solder various joints using ½" and ¾" copper tubing.
- d. Perform the soldering of a lap joint.

### Module 24: Brazing (Optional)

**Suggested Time:** 5-10 hours

**Level:** Advanced

**Prerequisite:** None

**Outcome**

Perform a brazing weld on gauge mild steel and explain how it is different from other types of welding.

**Indicators**

- a. Investigate and articulate the differences between welding, brazing, and braze welding.
- b. Perform a brazing weld on 16, 18, and/or 20 gauge mild steel in the flat position.
- c. Braze weld vertical up on 3/8" vee butt using mild steel or cast iron.

### Module 25A: Gas Metal Arc Welding (GMAW) Safety and Equipment (Core)

**Suggested Time:** 2-3 hours

**Level:** Introductory

**Prerequisite:** None

**Outcome**

Apply safety principles and practices to the use of GMAW equipment.

**Indicators**

- a. Compile information related to the GMAW process including care and maintenance of equipment, GMAW equipment and process, shielding gases, types of wire, weld faults and causes, and advantages and disadvantages of GMAW.
- b. Assess whether there are additional safety concerns for GMAW over oxy-acetylene and arc welding.

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### Module 25B: GMAW Safety and Equipment (Core)

**Suggested Time:** 1-2 hours

**Level:** Intermediate

**Prerequisite:** Module 25A

#### Outcome

Demonstrate and explain the importance of employing the correct start-up and shut-down procedures for GMAW equipment.

#### Indicators

- a. Review personal protective equipment (PPE) standards for usage.
- b. Adjust the machine for appropriate wire speed, voltage, and amperage.
- c. Turn on shielding gas and describe the reading on the flow meter.
- d. Demonstrate the correct start-up and shut-down procedures, including checking and cleaning up the work station.

### Module 25C: GMAW Safety and Equipment (Core)

**Suggested Time:** 1-2 hours

**Level:** Intermediate

**Prerequisites:** Modules 25A and B

#### Outcome

Set up GMAW equipment successfully, including care and maintenance.

#### Indicators

- a. Demonstrate knowledge of GMAW equipment such as nozzle, contact tips, liners, wire rolls, gauges and flow meters, amperage adjustment, and voltage adjustment.
- b. Compare the various types of wire and shielding gases used for GMAW.
- c. Disassemble, clean, and reassemble GMAW welder components.

### Module 25D: GMAW Safety and Equipment (Core)

**Suggested Time:** 1-2 hours

**Level:** Advanced

**Prerequisites:** Modules 25A, B, C

#### Outcome

Develop the effective use of GMAW equipment through an understanding of the science of welding.

#### Indicators

- a. Justify the relationship between wire speed and amperage, as well as between welding voltage and arc length.
- b. Investigate the effects of backhand (pull) welding and forehand (push) welding.
- c. Analyze the effects of torch angle on weld penetration and weld appearance.
- d. Identify the probable causes of the following defects: surface porosity, sub-surface porosity, lack of fusion, burn through, and lack of penetration.
- e. Identify strategies to evaluate and improve weld quality.
- f. Identify metals and perform preparation and assembly tasks prior to welding.

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**Module 26: GMAW Care and Maintenance Requirements (Core)****Suggested Time:** 1-2 hours**Level:** Introductory**Prerequisite:** None**Outcome**

Demonstrate knowledge of the care and maintenance of welding tools and equipment.

**Indicators**

- a. Demonstrate proper use of GMAW equipment assembly including disassembly of welding gun, adjustment of flow meter, and wire selection and installation.
- b. Safely operate hand tools, power hand tools, and power equipment.

**Module 27A: GMAW Procedures and Practice (Core)****Suggested Time:** 15-20 hours**Level:** Intermediate**Prerequisite:** Module 25A**Outcome**

Develop increasing skill using GMAW equipment.

**Indicators**

- a. Perform a forehand pad.
- b. Perform a backhand pad.
- c. Perform tack welding.
- d. Perform a lap weld downhand on 14 gauge steel.
- e. Perform a fillet weld downhand on 14 gauge steel.
- f. Perform a butt weld downhand on 14 gauge steel.
- g. Compare and chart personal progress to identify increasing skill.
- h. Assess personal technique and results in consultation with the instructor.

**Module 27B: GMAW Procedures and Practice (Core)****Suggested Time:** 7-10 hours**Level:** Intermediate**Prerequisites:** Modules 25B, 27A**Outcome**

Develop increasing skill using GMAW equipment.

**Indicators**

- a. Perform a horizontal fillet on 14 gauge steel.
- b. Perform a horizontal lap on 14 gauge steel.
- c. Perform a lap weld on ¼" mild steel.
- d. Perform horizontal fillets (¼" and ⅜" multi-pass on ¼" mild steel; short circuit transfer).
- e. Perform horizontal fillets (¼" and ⅜" multi-pass on ¼" mild steel; spray transfer).

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**Outcome****Indicators****Module 27B continued**

- f. Compare and chart personal progress to identify increasing skill.
- g. Assess personal technique and results in consultation with the instructor.

**Module 27C: GMAW Procedures and Practice (Core)****Suggested Time: 15-20 hours****Level: Intermediate****Prerequisites: Modules 25C, 27B****Outcome****Indicators****Note:** Bridge plates may be used for tacking vee butts together to allow for a fully opened root.**Develop increasing skill using GMAW welding equipment.**

- a. Perform vertical fillets (uphand;  $\frac{1}{4}$ " ,  $\frac{3}{8}$ " , and  $\frac{1}{2}$ " ).
- b. Perform  $\frac{3}{8}$ " vee butt flat (short circuit root, spray fill and cap) capable of successfully passing a bend test on root and face.

**Module 27D: GMAW Procedures and Practice (Core)****Suggested Time: 15-20 hours****Level: Advanced****Prerequisites: Modules 25D, 27C****Outcome****Indicators****Note:** Bridge plates may be used for tacking vee butts together to allow for a fully opened root.**Develop increasing skill using GMAW equipment to perform a variety of welds.**

- a. Perform  $\frac{3}{8}$ " vee butt vertical up (short circuit root and short circuit fill and cap) capable of passing a bend test on root and face.
- b. Perform an outside corner fillet, vertical up on  $\frac{1}{4}$ " mild steel.

**Note:** Welds in this module may also include specific job-related welds if student will transition to a workplace.**Module 28A: GMAW Projects (Optional)****Suggested Time: 5-10 hours****Level: Intermediate****Prerequisite: Module 27A****Outcome****Indicators****Complete an assigned or approved project using GMAW equipment.**

- a. Select a project through consultation with the instructor.
- b. Utilize skills developed in previous modules to complete a project.
- c. Utilize the following guidelines to complete a project:
  - Generate different project ideas
  - Plan and manage the project including assessment criteria in consultation with the instructor
  - Plan and use drawings with appropriate symbols
  - Set a procedural sequence

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**Outcome****Indicators****Module 28A continued**

- Prepare a material list and cost estimate
- Create a timeline
- Determine fabrication techniques
- Cut material and set up in the proper sequence
- Complete each part as specified
- Interpret and follow directions
- Adhere to timelines
- Work cooperatively
- Follow all safety requirements
- Follow all handling and storing procedures
- Fulfill cleanup and tool maintenance responsibilities
- Present the completed project and complete a self-assessment based on the criteria for the project.

**Module 28B: GMAW Projects (Optional)****Suggested Time: 5-10 hours****Level: Advanced****Prerequisite: Module 27B****Outcome****Indicators**

Design and complete an approved project using GMAW equipment.

- a. Develop a project plan, using appropriate dimensions and symbols, through consultation with the instructor.
- b. Carry out the stages of project development as outlined in Module 28A.
- c. Create a cutting list as well as projected costs for materials and time.
- d. Demonstrate a high level of proficiency in GMAW techniques.

**Module 29: Personal Skills for Success (Optional)****Suggested Time: 1-2 hours****Level: Introductory****Prerequisite: None****Outcome****Indicators**

Analyze workplace skills, knowledge, and attitudes that lead to successful employment.

- a. Establish a relationship with others in a workplace or shop setting by clearly defining the roles and using effective communication.
- b. Develop a résumé or a skills list to forward to an employer.
- c. Determine and practise guidelines used to participate in interviews.

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### Module 30: Employability Skills and Workplace Expectations (Optional)

Suggested Time: 1-2 hours

Level: Intermediate

Prerequisite: None

#### Outcome

**Integrate classroom learning with work-related experience to develop an awareness of employability skills and workplace expectations.**

#### Indicators

- a. Research to gain knowledge of the world of work in the welding industry.
- b. Develop an awareness of the Employability Skills which would be important to be successful in the workplace.
- c. Investigate the Essential Skills and identify which would be most important to a career in welding.

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### Module 31A, B, and C: Work Study Preparation (Optional)

Suggested Time: 3-5 hours

Level: Intermediate/Advanced

Prerequisite: None

#### Outcome

**Note:** Work Study is used to prepare students for employment through specific skill development within a workplace. The number of work study opportunities is equal to the number of courses available in the curriculum area at the 20 and 30 level.

**Recognize how school-based skills development will be used to meet workplace expectations.**

#### Indicators

- a. Obtain a list of roles and responsibilities of the workplace.
- b. Brainstorm a list of factors which may affect workplace performance.
- c. Discuss effective and positive verbal and non-verbal communication.
- d. Develop a résumé which can be forwarded to a potential employer.
- e. Practise effective interview techniques based on established guidelines including the greeting, the exchange, and the parting.

**Note:** For more information about implementing work study in schools, see the Work-based Learning Guidelines for the Practical and Applied Arts included in the Practical and Applied Arts Handbook. In collaboration with the cooperating employer, the training plan for the student should be designed to relate to the outcomes of the course modules chosen.

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### Module 32A, B, and C: Work Study Placement (Optional)

Suggested Time: 25-50 hours

Level: Intermediate/Advanced

Prerequisite: Module 31A, B, or C respectively

#### Outcome

Gain experience in the world of work to make more informed choices about careers by expanding the career research and exploration beyond the classroom.

#### Indicators

- a. Develop an awareness of career and opportunities in Saskatchewan and possibly other provinces.
- b. Gain an opportunity for the development of entry level workplace skills that may lead to sustainable employment.
- c. Establish standards of work performance acceptable to the student and employer.
- d. Demonstrate the required skills and perform the duties expected by the employer.
- e. Identify and report on essential skills and employability skills as they relate to a work environment.

**Note:** For more information about implementing work study in schools, see the Work-based Learning Guidelines for the Practical and Applied Arts included in the Practical and Applied Arts Handbook. In collaboration with the cooperating employer, the training plan for the student should be designed to relate to the outcomes of the course modules chosen.

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### Module 33A, B, and C: Work Study Follow-up (Optional)

Suggested Time: 2-4 hours

Level: Intermediate/Advanced

Prerequisite: Module 32A, B, or C respectively

#### Outcome

Reflect and report on the work experience including but not limited to hours of work, personal relationships, employer expectations, evaluation criteria, and overall personal performance.

#### Indicators

- a. Design and participate in an exit interview with the workplace.
- b. Prepare and present a report on the work study experience including aspects such as:
  - Expected hours of work
  - Dress code and personal protective equipment (PPE)
  - Job description
  - Employer expectations
  - Absence and late policies
  - Problem solving
  - Communication.

**Note:** For more information about implementing work study in schools, see the Work-based Learning Guidelines for the Practical and Applied Arts included in the Practical and Applied Arts Handbook. In collaboration with the cooperating employer, the training plan for the student should be designed to relate to the outcomes of the course modules chosen.

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### Module 34: Careers in Welding (Optional)

**Suggested Time:** 2-5 hours

**Level:** Introductory

**Prerequisite:** None

#### **Outcome**

Determine personal skills and interests that could lead to a career in the welding trade through an apprenticeship, technical school training, or paid work.

#### **Indicators**

- a. Compare the transition from high school to apprenticeship to that of high school to further classroom instruction at university or college.
- b. Develop a list of career opportunities related to the field of welding.
- c. Identify entrepreneurial opportunities available to people in the welding profession.
- d. Appraise a list of personal skills and traits that could lead to a career in the welding industry.

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### Module 88: Apprenticeship in Saskatchewan (Optional)

**Suggested Time:** 3-5 hours

**Level:** Introductory

**Prerequisite:** None

#### **Outcome**

Investigate the apprenticeship and trade certification process and the role of the Saskatchewan Apprenticeship and Trade Certification Commission (SATCC), opportunities that apprenticeship offers, and the relationship between secondary level courses and apprenticeship training.

#### **Indicators**

- a. Research to define what apprenticeship means and describe some of the benefits such as lifestyle, satisfaction, opportunities, wages, and respect.
- b. Use and understand the appropriate terminology related to apprenticeship including but not limited to:
  - Journey person
  - Indenture
  - Pre-employment training
  - Designated trade and sub-trade
  - Advanced standing.
- c. Determine the steps involved in becoming an apprentice from the perspective of the specific trade, including length of apprenticeship, annual training requirements, and Red Seal certification.
- d. Develop an understanding of the programs available to help make the transition from secondary school to apprenticeship.
- e. Conduct research such as interviewing employers to identify the qualities of a successful apprentice.



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**Module 99 A, B, C, D: Extended Study (Optional)****Suggested Time: 10-25 hours****Level: Introductory/  
Intermediate/Advanced****Prerequisite: None**

**Note:** The extended study module may be used only once in each 100 hour course. In the Student Data System record 99A for the first extended study module offered in the course series and, if needed, 99B for the second, 99C for the third, and 99D for the fourth.

**Module Overview:** Evolving societal and personal needs, advances in technology, and demands to solve current problems require a flexible curriculum that can accommodate new ways and means to support learning in the future. The extended study module is designed to provide schools and teachers with an opportunity to meet current and future demands not provided for in current modules of the PAA curriculum.

This flexibility allows a school or teacher to design one new module per credit to complement or extend the study of the core and optional modules to meet the specific needs of students or the community. The extended study module is designed to extend the content of the pure courses and to offer survey course modules beyond the scope of the available selection of PAA modules, either in depth or breadth.

The list of possibilities for topics of study or projects for the extended study module approach is as varied as the imagination of those involved in using the module. The extended study module guidelines should be used to strengthen the knowledge, skills, and processes advocated in the PAA curriculum.

For more information on the guidelines for the Extended Study module, see the Practical and Applied Arts Handbook.

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## Assessment and Evaluation of Student Learning

Assessment and evaluation require thoughtful planning and implementation to support the learning process and to inform teaching. All assessment and evaluation of student achievement must be based on the outcomes in the provincial curriculum.

Assessment involves the systematic collection of information about student learning with respect to:

- Achievement of provincial curriculum outcomes
- Effectiveness of teaching strategies employed
- Student self-reflection on learning.

Evaluation compares assessment information against criteria based on curriculum outcomes for the purpose of communicating to students, teachers, parents/caregivers, and others about student progress and to make informed decisions about the teaching and learning process.

Reporting of student achievement must be in relation to curriculum outcomes. Assessment information which is not related to outcomes can be gathered and reported (e.g., attendance, behaviour, general attitude, completion of homework, effort) to complement the reported achievement related to the outcomes of Welding. There are three interrelated purposes of assessment. Each type of assessment, systematically implemented, contributes to an overall picture of an individual student's achievement.

**Assessment for learning** involves the use of information about student progress to support and improve student learning and inform instructional practices, and:

- is teacher-driven for student, teacher, and parent use
- occurs throughout the teaching and learning process, using a variety of tools
- engages teachers in providing differentiated instruction, feedback to students to enhance their learning, and information to parents in support of learning.

**Assessment as learning** involves student reflection on and monitoring of her/his own progress related to curricular outcomes and:

- is student-driven with teacher guidance for personal use
- occurs throughout the learning process
- engages students in reflecting on learning, future learning, and thought processes (metacognition).

*What are examples of assessments as learning that could be used in Welding and what would be the purpose of those assessments?*

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**Assessment of learning** involves teachers' use of evidence of student learning to make judgements about student achievement and:

- provides opportunity to report evidence of achievement related to curricular outcomes
- occurs at the end of a learning cycle, using a variety of tools
- provides the foundation for discussion on placement or promotion.

In welding, students need to be regularly engaged in assessment as learning. The various types of assessments should flow from the learning tasks and provide direct feedback to the students regarding their progress in attaining the desired learnings as well as opportunities for the students to set and assess personal learning goals related to the content of Welding.

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## Glossary

**Alternating current:** Electricity that has the direction of electron flow reversed in regular intervals.

**Ampere:** Unit of electrical current. One ampere is the flow through a conductor having a resistance of one ohm at a potential (pressure) of one volt.

**Anode:** Positive terminal of an electric current.

**Anvil:** A heavy, usually steel, block on which metal is shaped.

**Apprenticeship:** A system of training and certification in a skilled trade.

**Arc:** Flow of electricity through a gaseous space or air gap.

**Backfire:** Short “pop” of the torch flame followed by extinguishing of the flame or continued burning of gases.

**Backhand welding (pull):** Moving the weld in opposite direction to which gas flame is pointing.

**Backing (backup):** Material that is placed on the root side of a weld to aid in the control of penetration.

**Backstep welding:** Welding small sections of a joint in a direction opposite the progression of the weld as a whole.

**Base metal:** Metal to be welded, cut, or brazed.

**Bead:** The appearance of the finished weld. Also, the metal added in welding.

**Bend test:** A flat of metal with a welded joint is bent into a U-shape, stretching the material on the outer surface of the “U,” while compressing the material on the inside surface.

**Bessemer furnace:** A gas-fired furnace used in removing impurities from pig iron by an air blast.

**Bevel:** An angle cut on the edge of the base metal in a weld joint to create a groove form.

**Brazing:** Making an adhesion groove, fillet, or plug weld above 450° C.

**Burn through:** The forceful ejection of molten metal from the weld. Severe burn-through may eject enough material to create a through-hole in the workpiece.

**Butt weld:** An assembly in which the two pieces joined are in the same plane, with the edge of one piece touching the edge of the other.

**Capillary attraction:** Property of a liquid to move into small spaces if it has the ability to “wet” those surfaces.

**Cast iron:** An alloy of iron, carbon, and silicon that is cast in a mold and is hard, brittle, non-malleable, but more easily fusible than steel.

**Cathode:** Negative terminal of an electric current.

**Circuit:** The path of electron flow from a source through components and connections back to the source.

**Cold rolled:** Metal shaped between rollers in a mill without being heated.

**Complete penetration:** A situation in which weld metal completely fills the groove and fuses with the base metal through its entire thickness.

**Constant current:** Power sources which keep the amperage constant even though the voltage changes.

**Contraction:** The process of shortening or shrinking of metal as it cools.

**Corner weld:** The junction formed by edges of two pieces of metal touching each other at an angle of about 90 degrees (a right angle).

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**Cover glass:** A removable pane of clear glass or plastic used to protect the expensive filtering welding lens.

**Cracking:** The act of opening a valve slightly, then closing it immediately. Cracking is used to blow out any dust in the valve orifice.

**Crater:** A depression in the face of a weld, usually at the termination of a weld. The crater is visible after the weld has cooled.

**Cutting list:** A written description of all the pieces needed to assemble a complete project including individual dimensions.

**Cutting torch:** Nozzle or device that controls and directs the gases and oxygen needed for cutting and removing the metal in oxyfuel gas cutting.

**Direct current:** An electric current flowing in one direction only, either to the workpiece or to the electrode.

**Distortion:** Warping of a part of a structure.

**Downhand welding:** Welding with a downward progression.

**Ductility:** The ability of a material to be changed in shape without cracking or breaking.

**Duty cycle:** The percentage of time in a 10-minute period that an arc welding machine can be used at its rated output without overloading. A resistance welding machine duty cycle is usually calculated over a 1-minute period.

**Edge weld:** A joint between the edges of two or more parallel parts.

**Elasticity:** Ability of a material to regain its original size and shape after deformation.

**Electrode:** Terminal point to which electricity is brought in the welding operation and from which the arc is produced to do the welding. In most electric arc welding, the electrode is usually melted and becomes a part of the weld.

**Employability Skills:** The critical skills needed in the workplace - whether self-employed or working for others. The Employability Skills 2000+ are developed by the Conference Board of Canada.

**Entrepreneur:** One who organizes, manages, and assumes the risks of a business.

**Essential Skills:** Skills needed for work, learning, and life which provide the foundation for learning all other skills and enable people to evolve with their jobs and adapt to workplace change. The Essential Skills are developed by Human Resources and Skills Development Canada.

**Expansion:** To increase in size due to the addition of heat.

**Ferrous:** A metal containing iron.

**Filler rod:** Metal rod that is melted into the weld metal.

**Fillet:** Metal fused into a corner formed by two pieces of metal whose welded surfaces are approximately 90 degrees to each other.

**Finished surface:** The finished contour of a weld, usually in a normal contour, a concave contour, or ground flat.

**Flashback:** A burning back of the gases into the oxy-acetylene gas torch, hoses, and possibly into the regulator and cylinder. This is a very dangerous situation.

**Flat position:** Horizontal weld on the upper side of a horizontal surface.

**Flow meter:** Device which regulates the volume of gas coming out of a nozzle; usually calibrated in cubic feet per hour or litres per minute.

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**Flux:** Material used to prevent, dissolve, or help remove oxides and other undesirable surface substances.

**Forehand welding (push):** Welding in the same direction that the flame is pointing.

**Fusion welding:** Any type of welding that used fusion as part of the process.

**Gas pockets:** Cavities in weld metal caused by entrapped gas.

**Gaseous shield:** Inert gases which protect the arc, metal electrode, and weld metal from contamination during the welding process.

**Gauge:** The thickness of sheet metal or the diameter of wire.

**Generator:** Mechanism that generates electricity or produces some substance; for example, an electric generator or an acetylene generator.

**GMAW:** Gas Metal Arc Welding. Arc welding using a continuously fed consumable electrode and a shielding gas. Sometimes incorrectly called "MIG welding".

**High carbon steel:** Steel with a high carbon content is hard, strong, but brittle.

**Hot rolled:** Metal shaped between rollers in a mill after being heated.

**Kerf:** Width of cut produced by a cutting operation.

**Lap weld:** A weld in which the edges of the two metals to be joined overlap.

**Lens:** Specially treated glass or plastic through which a welder may look at an intense flame or arc without being injured by the harmful rays or glare.

**Lines of fusion:** Melting together of filler metal and base metal or base metal alone in a continuous line.

**Low carbon steel:** Steel with low carbon content is soft, not very strong, and easily bendable.

**Metallurgy:** The science and technology of metal.

**MIG:** A nonstandard term. See GMAW.

**MSDS:** Material System Data Sheets.

**Non-ferrous:** A metal that contains no iron.

**Nozzle:** A device that directs a shielding medium or gas.

**Overhead position:** Weld made on the underside of the joint with the face of the weld in a horizontal position.

**Oxy-acetylene:** A gas mixture of oxygen and acetylene used as fuel.

**Padding:** Weld filler metal added to build up a plate to make the plate thicker. It is used to restore a dimension to a worn part or to apply an extra hard wear surface.

**Parent metal:** Metal to be welded.

**Peening:** Hitting metal with a hammer to mark the surface or shape the metal.

**Penetration:** The extent to which the weld metal combines with the base metal, as measured from the surface to the base metal.

**Pig iron:** Cooled form of iron produced during the first stage of iron ore refinement.

**Plasma arc cutting:** A metal cutting process that uses an electric arc and fast-flowing ionized gases.

**Polarity:** The direction of flow of electrons in a closed direct current welding circuit.

**Porosity:** Gas pockets or voids in a metal.

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**Rate of travel:** The speed at which the weld pool travels across the parent metal.

**Rectifier:** A device, such as a diode or a circuit, that acts like a one-way valve. It converts one half of a waveform of alternating current to useful current flowing in the same direction as the other half of the waveform.

**Regulator:** An automatic valve used to reduce cylinder pressures to torch pressures and to keep the pressures constant.

**Reverse polarity:** Current flowing from the work to the electrode.

**Root opening:** The space at the bottom of the joint between the pieces being welded.

**Shielding gas:** Gas which flows around a weld pool to protect the weld from air and other harmful materials.

**Slag:** Nonmetallic by-product of smelting and refining made up of flux and nonmetallic impurities. Also, material that forms on the underside of an oxy-acetylene gas or arc cut.

**Soldering:** A means of fastening metals together by adhering one metal to another metal at a temperature below 450° C. Only the filler metal is melted.

**Spatter:** Small pieces of metal that have been ejected from molten pool and attach to base material outside the weld.

**Stainless steel:** Alloy of iron containing at least 11% chromium and some nickel that resists almost all forms of rusting and corrosion.

**Straight polarity:** Current flowing from the electrode to the work.

**Strain:** Reaction of an object to stress.

**Stress:** A load imposed on an object.

**Striking an arc:** To produce an arc between the metal electrode and the base metal. The electrode must first touch the base metal and then be withdrawn to the correct distance.

**Tack weld:** Small weld used to temporarily hold components together.

**Tee weld:** Weld formed by placing one metal against another at an angle of 90° to form a "T" shape.

**Tensile strength:** Maximum pull stress in pounds per square inch or megapascals (newtons per square millimeter) that a specimen will withstand.

**Tip:** End of the torch where the gas burns, producing the high-temperature flame. In resistance welding, the electrode ends.

**Tolerance:** Permissible variation of a characteristic, variable, or parameter.

**Transformer:** Device used in welding power supplies and equipment to change voltage and current from one level to another.

**Undercut:** Depression at the toe of the weld that is below the surface of the base metal.

**Unintentional injury:** Not intentional instance of harm. Injuries that can be prevented if necessary precautions are taken.

**Uphand welding:** Welding with an upward progression.

**Vertical position:** Type of weld in which the welding is done in a vertical seam and on a vertical surface.

**Warping:** Distortion of the metal pieces being welded caused by heat.

**Wire speed:** The constant rate at which wire is from a GMAW machine through the weld gun.

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**Yield point:** The lowest stress to which a material of body can be subjected. The point at which strain increases without an appreciable or proportionate increase in stress.

**Yield strength:** Stress value in psi or kPa at which a specimen assumes a specified limiting permanent set.



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## Appendix A: Articulation with the Welding Trade

The Ministry of Education has developed adequate hours of provincial curriculum in welding that combined with practical experience meet much of the Level 1 skills and knowledge required by apprentices as outlined by the Saskatchewan Apprenticeship and Trade Certification Commission (SATCC).

### **Benefit**

Students who successfully complete a Practical and Applied Arts (PAA) Welding credit, supervised by a teacher who is a journeyman in welding, may apply for pre-employment technical training credit. This credit will provide advanced standing for verifiable hours when the student indentures as an apprentice. In other words, the time required to complete a high school welding credit will be considered to be time worked in the trade as an apprentice.

### **Teacher Qualifications**

Only a teacher who is a journeyman in welding can authorize pre-employment technical training hours at the school level for welding.

### **Documentation**

Students wishing to apply in the future for the benefit of credit for pre-employment technical training hours in welding must have a Form 6A completed and signed by the teacher/journeyman. A copy of Form 6A can be obtained on the SATCC website at [www.saskapprenticeship.ca](http://www.saskapprenticeship.ca) under each designated trade.

### **Credit**

A high school graduate who has received credit for welding will receive 100 hours of pre-employment technical training credit for each pure high school welding course completed. For example, a student completing all of the Welding 10, 20, A30, B30 course can use a Form 6 to apply for 400 hours to be applied to his/her first level of apprenticeship which will reduce the amount of time to complete a journey certificate.

Students may also apply for pre-employment technical training credit if they have worked in the trade supervised by a journeyman during a work study in a PAA class or during a work placement in Career and Work Exploration.

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## Feedback Form

The Ministry of Education welcomes your response to this curriculum and invites you to complete and return this feedback form.

### Welding 10, 20, A30, B30 Curriculum

1. Please indicate your role in the learning community:

- parent                       teacher                       resource teacher  
 guidance counsellor       school administrator       school board trustee  
 teacher librarian               school community council member  
 other \_\_\_\_\_

What was your purpose for looking at or using this curriculum?

2. a) Please indicate which format(s) of the curriculum you used:

- print  
 online

b) Please indicate which format(s) of the curriculum you prefer:

- print  
 online

3. Please respond to each of the following statements by circling the applicable number.

The curriculum content is:	Strongly Agree	Agree	Disagree	Strongly Disagree
appropriate for its intended purpose	1	2	3	4
suitable for your use	1	2	3	4
clear and well organized	1	2	3	4
visually appealing	1	2	3	4
informative	1	2	3	4

4. Explain which aspects you found to be:

Most useful:

Least useful:

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5. Additional comments:

6. Optional:

Name: \_\_\_\_\_

School: \_\_\_\_\_

Phone: \_\_\_\_\_ Fax: \_\_\_\_\_

Thank you for taking the time to provide this valuable feedback.

Please return the completed feedback form to:

Executive Director  
Curriculum and E-Learning Branch  
Ministry of Education  
2220 College Avenue  
Regina SK S4P 4V9  
Fax: 306-787-2223