Applied Design, Skills, and Technologies

Core Competencies

Big Ideas

Social, ethical, and sustainability considerations impact design.

Complex tasks require the sequencing of skills.

Complex tasks require different technologies and tools at different stages.

BIG IDEAS

Products can be **designed for life cycle**.	Personal design interests require the evaluation and refinement of skills.	Tools and technologies can be adapted for specific purposes.

Learning Standards

Curricular Competencies	Content
Students are expected to be able to do the following: **Applied Design** *Understanding context* • Conduct **user-centred research** to understand design opportunities and barriers ***Defining*** • Choose a design opportunity and point of view • Identify potential users, intended impact, and possible unintended negative consequences • Make inferences about premises and **boundaries** that define the design space ***Ideating*** • Take creative risks to identify gaps to explore as design space • Generate ideas to create a range of possibilities and add to others' ideas in ways that create additional possibilities • Critically analyze how competing social, ethical, and sustainability considerations impact designed solutions to meet global needs for preferred futures • Prioritize ideas for prototyping and **designing with users** *Prototyping* • Identify and use a variety of **sources of inspiration** and **information** • Choose an appropriate form, scale, and level of detail for prototyping, and plan procedures for prototyping multiple ideas • Analyze the **design for life cycle** • Construct prototypes, making changes to tools, materials, and procedures as needed • Record **iterations** of prototyping	*Students are expected to know the following:* • traditional and modern techniques related to the creation of jewellery • use of visual **art elements** and image design to create emotional response and convey ideas • concepts related to the creation of art with the primary medium being metal • incorporation of **other materials** to enhance the final product • use, purpose, and traditions of **high-value** material • various forms of **casting** • detail-oriented **welding** • material selection for specific applications • application and purpose of **finishes and polishes** • carving **mediums** for transfer to metal • layout and use of materials to minimize waste and conserve material • uses of **power** and **non-power** tools

Learning Standards (continued)

Curricular Competencies	Content
Testing • Identify feedback most needed and possible **sources of that feedback** • Develop an **appropriate test** of the prototype • Gather feedback from users over time to critically evaluate their design and make changes to product design or processes • Iterate the prototype or abandon the design idea *Making* • Identify appropriate tools, technologies, materials, processes, **potential funding sources**, and time needed for production, and where/how these could be available • Use project management processes when working individually or collaboratively to coordinate production *Sharing* • **Share** their progress while making to increase feedback, collaboration, and, if applicable, marketing • Decide on how and with whom to share or promote their **product**, creativity, and, if applicable, intellectual property • Critically evaluate their design thinking and processes, and their ability to work effectively both as individuals and collaboratively in a group, including the ability to implement project management processes • Identify new design issues, including how they or others might build on their concept **Applied Skills** • Demonstrate an awareness of safety issues for themselves, co-workers, and users in both physical and digital environments • Identify and evaluate their skills and skill levels, in relation to their project or design interests, and develop specific plans to learn or refine their skills over time **Applied Technologies** • Explore existing, new, and emerging tools, **technologies**, and systems and evaluate their suitability for their design interests • Analyze the role and impact of technologies in societal change, and the personal, social, and environmental impacts, including unintended negative consequences, of their choices of technology use • Analyze how cultural beliefs, values, and ethical positions affect the development and use of technologies	

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Big Ideas – Elaborations

- **designed for life cycle:** taking into account in the design process, economic costs, and social and environmental impacts of the product, from the extraction of raw materials to eventual reuse or recycling of component materials

APPLIED DESIGN, SKILLS, AND TECHNOLOGIES – Art Metal and Jewellery
Grade 12

Curricular Competencies – Elaborations

- **user-centred research:** research done directly with potential users to understand how they do things and why, their physical and emotional needs, how they think about the world, and what is meaningful to them
- **Defining:** setting parameters
- **boundaries:** limiting factors, such as available technology, expense, environmental impact, issues of appropriation, and knowledge that is considered sacred
- **Ideating:** forming ideas or concepts
- **designing with users:** working with users at all stages of the design process
- **sources of inspiration:** may include experiences; traditional cultural knowledge and approaches, including those of First Peoples; places, including the land and its natural resources and analogous settings; and people, including users, experts, and thought leaders
- **information:** for example, other people as experts (e.g., First Peoples Elders), secondary sources, collective pools of knowledge in communities, collaborative atmospheres
- **design for life cycle:** including the social and environmental impacts of extraction and transportation of raw materials, manufacturing, packaging, transportation to markets, servicing or providing replacement parts, expected usable lifetime, and reuse or recycling of component materials
- **iterations:** repetitions of a process with the aim of approaching a desired result
- **sources of that feedback:** may include peers; users; keepers of traditional cultural knowledge and approaches, including those of First Peoples; and other experts
- **appropriate test:** includes evaluating the degree of authenticity required for the setting of the test, deciding on an appropriate type and number of trials, and collecting and compiling data
- **potential funding sources:** It is not the intent, and not appropriate, for students to have to raise funds in order to complete their school project. Students may, however, wish to investigate sources of funding for the commercial development of their products.
- **share:** may include showing to others, use by others, giving away, or marketing and selling
- **product:** for example, a physical product, a process, a system, a service, or a designed environment
- **technologies:** things that extend human capabilities

Content – Elaborations

- **art elements:** line, shape, space, texture, colour, form, tone, pattern, repetition, balance, contrast, emphasis, rhythm, movement, variety, proportion, magnification, reversal, fragmentation, distortion
- **other materials:** for example, glass, gems, jewels
- **high-value:** gold, silver, brass, bronze
- **casting:** sand, investment, spin
- **welding:** brazing, soldering, wire welding, gas welding
- **finishes and polishes:** for example, brushed, satin, matte, hammered, textured, flame, rhodium
- **mediums:** for example, soapstone, cuttlebone, foam
- **power:** for example, rotary tool, ultrasonic cleaner/polisher, engraver, soldering iron
- **non-power:** for example, file, jeweller's saw, flat-nosed pliers, bead crimper, ring gauge, polisher, tumbler, burnisher, roller

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Learning Standards (continued)

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- **Defining:** setting parameters
- **boundaries:** limiting factors, such as available technology, expense, environmental impact, issues of appropriation, and knowledge that is considered sacred
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- **appropriate test:** includes evaluating the degree of authenticity required for the setting of the test, deciding on an appropriate type and number of trials, and collecting and compiling data
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- **share:** may include showing to others, use by others, giving away, or marketing and selling
- **product:** for example, a physical product, a process, a system, a service, or a designed environment
- **technologies:** things that extend human capabilities

Content – Elaborations

- **tools:** for example, charging analyzer, timing light, fuel pressure gauge, separating tool
- **equipment:** for example, brake lathe, alignment
- **modifications:** for example, turbocharging, supercharging, lifting, lowering, tuning

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Learning Standards

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Applied Design	• coding as an **analytical process**
Understanding context	• basic **movements** in coding language
• Conduct **user-centred research** to understand design opportunities and barriers	• file conversion from **3D model** to code for machine processing
Defining	• geometric construction in creating **drawings and images**
• Choose a design opportunity and point of view	• design visualization through computer modelling
• Identify potential users, intended impact, and possible unintended negative consequences	• machining **standards** for working with **different materials**
• Make inferences about premises and **boundaries** that define the design space	• **tooling** and tool motion for **computer numerical control (CNC) equipment**
Ideating	• use of code in creating a product through a reproducible means
• Take creative risks to identify gaps to explore as design space	• multiple **platforms** for manufacturing product
• Generate ideas to create a range of possibilities and add to others' ideas in ways that create additional possibilities	• processes for creating a working part or product that is easily replicated from a working drawing
• Critically analyze how competing social, ethical, and sustainability considerations impact designed solutions to meet global needs for preferred futures	• how manufacturing relates to **industrial production**
• Prioritize ideas for prototyping and **designing with users**	• the relationships between manufacturing, drafting, engineering, and industrial design
Prototyping	• how to model 2D and 3D designs using industry standard computer programs
• Identify and use a variety of **sources of inspiration** and **information**	
• Choose an appropriate form, scale, and level of detail for prototyping, and plan procedures for prototyping multiple ideas	
• Analyze the **design for life cycle**	
• Construct prototypes, making changes to tools, materials, and procedures as needed	
• Record **iterations** of prototyping	

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Big Ideas – Elaborations

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APPLIED DESIGN, SKILLS, AND TECHNOLOGIES – Coding for Manufacturing
Grade 12

Curricular Competencies – Elaborations

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- **technologies:** things that extend human capabilities

- **analytical process:** data are categorized to facilitate analysis used in the process of designing, writing, testing, debugging, troubleshooting, and maintaining source code
- **movements:** x and y axis, z axis, curves, circular interpolation, jogging, rapid movements
- **3D model:** for example, .stl, .dwg, .dxl, .ipt, .iam, .ipj
- **drawings and images:** basic sketches, orthographic projections, pictorials, and working drawings
- **standards:** for example, machine feed and speed, depth of cut
- **different materials:** for example, metal, wood, plastic
- **tooling:** for example, 3- and 4-flute cutters, v-cutters, drills
- **computer numerical control (CNC) equipment:** for example, lathe, router, mill, waterjet, plasma
- **platforms:** for example, computer numerical control (CNC), mill, lathe, plasma, water jet, 3D printer, laser
- **industrial production:** raw materials are transformed into finished goods on a large scale

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Learning Standards (continued)

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Testing • Identify feedback most needed and possible **sources of that feedback** • Develop an **appropriate test** of the prototype • Gather feedback from users over time to critically evaluate their design and make changes to product design or processes • Iterate the prototype or abandon the design idea *Making* • Identify appropriate tools, technologies, materials, processes, **potential funding sources**, and time needed for production, and where/how these could be available • Use project management processes when working individually or collaboratively to coordinate production *Sharing* • **Share** their progress while making to increase feedback, collaboration, and, if applicable, marketing • Decide on how and with whom to share or promote their **product**, creativity, and, if applicable, intellectual property • Critically evaluate their design thinking and processes, and their ability to work effectively both as individuals and collaboratively in a group, including the ability to implement project management processes • Identify new design issues, including how they or others might build on their concept **Applied Skills** • Demonstrate an awareness of safety issues for themselves, co-workers, and users in both physical and digital environments • Identify and evaluate their skills and skill levels, in relation to their project or design interests, and develop specific plans to learn or refine their skills over time **Applied Technologies** • Explore existing, new, and emerging tools, **technologies**, and systems and evaluate their suitability for their design interests • Analyze the role and impact of technologies in societal change, and the personal, social, and environmental impacts, including unintended negative consequences, of their choices of technology use • Analyze how cultural beliefs, values, and ethical positions affect the development and use of technologies	

Big Ideas – Elaborations

- **designed for life cycle:** taking into account in the design process, economic costs, and social and environmental impacts of the product, from the extraction of raw materials to eventual reuse or recycling of component materials

APPLIED DESIGN, SKILLS, AND TECHNOLOGIES – Drafting
Grade 12

Curricular Competencies – Elaborations

- **user-centred research:** research done directly with potential users to understand how they do things and why, their physical and emotional needs, how they think about the world, and what is meaningful to them
- **Defining:** setting parameters
- **boundaries:** limiting factors, such as available technology, expense, environmental impact, issues of appropriation, and knowledge that is considered sacred
- **Ideating:** forming ideas or concepts
- **designing with users:** working with users at all stages of the design process
- **sources of inspiration:** may include experiences; traditional cultural knowledge and approaches, including those of First Peoples; places, including the land and its natural resources and analogous settings; and people, including users, experts, and thought leaders
- **information:** for example, other people as experts (e.g., First Peoples Elders), secondary sources, collective pools of knowledge in communities, collaborative atmospheres
- **design for life cycle:** including the social and environmental impacts of extraction and transportation of raw materials, manufacturing, packaging, transportation to markets, servicing or providing replacement parts, expected usable lifetime, and reuse or recycling of component materials
- **iterations:** repetitions of a process with the aim of approaching a desired result
- **sources of that feedback:** may include peers; users; keepers of traditional cultural knowledge and approaches, including those of First Peoples; and other experts
- **appropriate test:** includes evaluating the degree of authenticity required for the setting of the test, deciding on an appropriate type and number of trials, and collecting and compiling data
- **potential funding sources:** It is not the intent, and not appropriate, for students to have to raise funds in order to complete their school project. Students may, however, wish to investigate sources of funding for the commercial development of their products.
- **share:** may include showing to others, use by others, giving away, or marketing and selling
- **product:** for example, a physical product, a process, a system, a service, or a designed environment
- **technologies:** things that extend human capabilities

Content – Elaborations

- **complex drawings:** multi-view, working, and development
- **detailed drawings:** auxiliary views, sections, exploded assembly
- **components:** bill of materials and schedules, tolerances, and surface finishes
- **software management:** short-cut and customization techniques, modifying geometry using control points
- **specialization:** architectural, civil, mechanical, structural

Area of Learning: APPLIED DESIGN, SKILLS, AND TECHNOLOGIES — Engine and Drivetrain

BIG IDEAS

Products can be **designed for life cycle**.	Personal design interests require the evaluation and refinement of skills.	Tools and technologies can be adapted for specific purposes.

Learning Standards

Curricular Competencies	Content
Students are expected to be able to do the following: **Applied Design** *Understanding context* • Conduct **user-centred research** to understand design opportunities and barriers ***Defining*** • Choose a design opportunity and point of view • Identify potential users, intended impact, and possible unintended negative consequences • Make inferences about premises and **boundaries** that define the design space ***Ideating*** • Take creative risks to identify gaps to explore as design space • Generate ideas to create a range of possibilities and add to others' ideas in ways that create additional possibilities • Critically analyze how competing social, ethical, and sustainability considerations impact designed solutions to meet global needs for preferred futures • Prioritize ideas for prototyping and **designing with users** *Prototyping* • Identify and use a variety of **sources of inspiration** and **information** • Choose an appropriate form, scale, and level of detail for prototyping, and plan procedures for prototyping multiple ideas • Analyze the **design for life cycle** • Construct prototypes, making changes to tools, materials, and procedures as needed • Record **iterations** of prototyping	*Students are expected to know the following:* • valve timing, operation, and adjustment • compression ratios • ignition timing and adjustment • intake and exhaust performance, enhancement, and fabrication • fuel systems • braking systems • automatic and manual transmissions • wheel size, specification, and function • suspension systems • correlation between performance enhancements and original equipment manufacturer (OEM) parts • engine-related **diagnostic equipment** • hybrid and alternative fuel vehicles

Learning Standards (continued)

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Big Ideas – Elaborations

APPLIED DESIGN, SKILLS, AND TECHNOLOGIES – Engine and Drivetrain
Grade 12

- **designed for life cycle:** taking into account in the design process, economic costs, and social and environmental impacts of the product, from the extraction of raw materials to eventual reuse or recycling of component materials

Curricular Competencies – Elaborations

APPLIED DESIGN, SKILLS, AND TECHNOLOGIES – Engine and Drivetrain
Grade 12

- **user-centred research:** research done directly with potential users to understand how they do things and why, their physical and emotional needs, how they think about the world, and what is meaningful to them
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- **product:** for example, a physical product, a process, a system, a service, or a designed environment
- **technologies:** things that extend human capabilities

Content – Elaborations

APPLIED DESIGN, SKILLS, AND TECHNOLOGIES – Engine and Drivetrain
Grade 12

- **diagnostic equipment:** scanners, on-board diagnostics (OBD), timing lights

BIG IDEAS

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Learning Standards (continued)

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Learning Standards (continued)

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Big Ideas – Elaborations

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APPLIED DESIGN, SKILLS, AND TECHNOLOGIES – Electronics
Grade 12

Curricular Competencies – Elaborations

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- **share:** may include showing to others, use by others, giving away, or marketing and selling
- **product:** for example, a physical product, a process, a system, a service, or a designed environment
- **technologies:** things that extend human capabilities

Content – Elaborations

- **Kirchoff's law and rules:** deal with the conservation of current and energy within electrical circuits
- **gates and devices:** for example, buffer, inverter, AND, NOT,- NAND, OR, NOR, XOR, XNOR
- **chemicals:** for example, solvents, solder, etchant chemicals
- **testing equipment:** for example, oscilloscopes, multimeters, voltmeters, ammeter
- **analog systems:** for example, power amplifier, FM transmitter
- **digital systems:** for example, digital alarm clock, multi-segmented light-emitting diode (LED) chasers
- **microcontrollers:** for example, programmable logic controller (PLC), peripheral interface controller (PIC)

BIG IDEAS

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Learning Standards (continued)

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- **technologies:** things that extend human capabilities

Content – Elaborations

- **components:** for example, drawers, doors, slides, pull-outs
- **non-wood materials:** for example, glass, plastic, metal, upholstery, accents (e.g., decorative corners, escutcheons, capitals)
- **hardware:** hinges, handles, stops, slides, locks, latches
- **standard sizing:** heights, widths, depths; standards for tables, cabinets, and other products
- **wood material:** wood or wood products
- **setups:** for example, guard positions, blade and bit types, heights, stops and locks
- **techniques:** for example, hand-carving, stencilling, sculpting
- **reclamation:** restoration, repurposing hardware, recycling materials

BIG IDEAS

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Learning Standards (continued)

Curricular Competencies	Content
Testing • Identify feedback most needed and possible **sources of that feedback** • Develop an **appropriate test** of the prototype • Gather feedback from users over time to critically evaluate their design and make changes to product design or processes • Iterate the prototype or abandon the design idea *Making* • Identify appropriate tools, technologies, materials, processes, **potential funding sources**, and time needed for production, and where/how these could be available • Use project management processes when working individually or collaboratively to coordinate production *Sharing* • **Share** their progress while making to increase feedback, collaboration, and, if applicable, marketing • Decide on how and with whom to share or promote their **product**, creativity, and, if applicable, intellectual property • Critically evaluate their design thinking and processes, and their ability to work effectively both as individuals and collaboratively in a group, including the ability to implement project management processes • Identify new design issues, including how they or others might build on their concept **Applied Skills** • Demonstrate an awareness of safety issues for themselves, co-workers, and users in both physical and digital environments • Identify and evaluate their skills and skill levels, in relation to their project or design interests, and develop specific plans to learn or refine their skills over time **Applied Technologies** • Explore existing, new, and emerging tools, **technologies**, and systems and evaluate their suitability for their design interests • Analyze the role and impact of technologies in societal change, and the personal, social, and environmental impacts, including unintended negative consequences, of their choices of technology use • Analyze how cultural beliefs, values, and ethical positions affect the development and use of technologies	

BIG IDEAS

Products can be **designed for life cycle**.	Personal design interests require the evaluation and refinement of skills.	Tools and technologies can be adapted for specific purposes.

Learning Standards

Curricular Competencies	Content
Students are expected to be able to do the following: **Applied Design** *Understanding context* • Conduct **user-centred research** to understand design opportunities and barriers ***Defining*** • Choose a design opportunity and point of view • Identify potential users, intended impact, and possible unintended negative consequences • Make inferences about premises and **boundaries** that define the design space ***Ideating*** • Take creative risks to identify gaps to explore as design space • Generate ideas to create a range of possibilities and add to others' ideas in ways that create additional possibilities • Critically analyze how competing social, ethical, and sustainability considerations impact designed solutions to meet global needs for preferred futures • Prioritize ideas for prototyping and **designing with users** *Prototyping* • Identify and use a variety of **sources of inspiration** and **information** • Choose an appropriate form, scale, and level of detail for prototyping, and plan procedures for prototyping multiple ideas • Analyze the **design for life cycle** • Construct prototypes, making changes to tools, materials, and procedures as needed • Record **iterations** of prototyping	*Students are expected to know the following:* • identification and selection of metal suitable for machining or welding processes • **machining** processes • **forms of welding** • precision measurement • procedures for inspection of quality • geometry and trigonometry related to machining • engineered drawings and blueprints • threads and fasteners • use of computers in the processing of material, computer-aided design (CAD), computer-aided manufacturing (CAM), computer numerical control (CNC)) • welding and machining in industry • connection between welding and machining in the creation of a project

Learning Standards (continued)

Curricular Competencies	Content
Testing • Identify feedback most needed and possible **sources of that feedback** • Develop an **appropriate test** of the prototype • Gather feedback from users over time to critically evaluate their design and make changes to product design or processes • Iterate the prototype or abandon the design idea *Making* • Identify appropriate tools, technologies, materials, processes, **potential funding sources**, and time needed for production, and where/how these could be available • Use project management processes when working individually or collaboratively to coordinate production *Sharing* • **Share** their progress while making to increase feedback, collaboration, and, if applicable, marketing • Decide on how and with whom to share or promote their **product**, creativity, and, if applicable, intellectual property • Critically evaluate their design thinking and processes, and their ability to work effectively both as individuals and collaboratively in a group, including the ability to implement project management processes • Identify new design issues, including how they or others might build on their concept **Applied Skills** • Demonstrate an awareness of safety issues for themselves, co-workers, and users in both physical and digital environments • Identify and evaluate their skills and skill levels, in relation to their project or design interests, and develop specific plans to learn or refine their skills over time **Applied Technologies** • Explore existing, new, and emerging tools, **technologies**, and systems and evaluate their suitability for their design interests • Analyze the role and impact of technologies in societal change, and the personal, social, and environmental impacts, including unintended negative consequences, of their choices of technology use • Analyze how cultural beliefs, values, and ethical positions affect the development and use of technologies	

Big Ideas – Elaborations

- **designed for life cycle:** taking into account in the design process, economic costs, and social and environmental impacts of the product, from the extraction of raw materials to eventual reuse or recycling of component materials

APPLIED DESIGN, SKILLS, AND TECHNOLOGIES – Machining and Welding
Grade 12

Curricular Competencies – Elaborations

- **user-centred research:** research done directly with potential users to understand how they do things and why, their physical and emotional needs, how they think about the world, and what is meaningful to them
- **Defining:** setting parameters
- **boundaries:** limiting factors, such as available technology, expense, environmental impact, issues of appropriation, and knowledge that is considered sacred
- **Ideating:** forming ideas or concepts
- **designing with users:** working with users at all stages of the design process
- **sources of inspiration:** may include experiences; traditional cultural knowledge and approaches, including those of First Peoples; places, including the land and its natural resources and analogous settings; and people, including users, experts, and thought leaders
- **information:** for example, other people as experts (e.g., First Peoples Elders), secondary sources, collective pools of knowledge in communities, collaborative atmospheres
- **design for life cycle:** including the social and environmental impacts of extraction and transportation of raw materials, manufacturing, packaging, transportation to markets, servicing or providing replacement parts, expected usable lifetime, and reuse or recycling of component materials
- **iterations:** repetitions of a process with the aim of approaching a desired result
- **sources of that feedback:** may include peers; users; keepers of traditional cultural knowledge and approaches, including those of First Peoples; and other experts
- **appropriate test:** includes evaluating the degree of authenticity required for the setting of the test, deciding on an appropriate type and number of trials, and collecting and compiling data
- **potential funding sources:** It is not the intent, and not appropriate, for students to have to raise funds in order to complete their school project. Students may, however, wish to investigate sources of funding for the commercial development of their products.
- **share:** may include showing to others, use by others, giving away, or marketing and selling
- **product:** for example, a physical product, a process, a system, a service, or a designed environment
- **technologies:** things that extend human capabilities

Content – Elaborations

- **machining:** milling, turning, precision grinding
- **forms of welding:** metal inert gas (MIG), tungsten inert gas (TIG), gas metal arc welding (GMAW)

BIG IDEAS

Products can be **designed for life cycle**.	Personal design interests require the evaluation and refinement of skills.	Tools and technologies can be adapted for specific purposes.

Learning Standards

Curricular Competencies	Content
Students are expected to be able to do the following: **Applied Design** *Understanding context* • Conduct **user-centred research** to understand design opportunities and barriers ***Defining*** • Choose a design opportunity and point of view • Identify potential users, intended impact, and possible unintended negative consequences • Make inferences about premises and **boundaries** that define the design space ***Ideating*** • Take creative risks to identify gaps to explore as design space • Generate ideas to create a range of possibilities and add to others' ideas in ways that create additional possibilities • Critically analyze how competing social, ethical, and sustainability considerations impact designed solutions to meet global needs for preferred futures • Prioritize ideas for prototyping and **designing with users** *Prototyping* • Identify and use a variety of **sources of inspiration** and **information** • Choose an appropriate form, scale, and level of detail for prototyping, and plan procedures for prototyping multiple ideas • Analyze the **design for life cycle** • Construct prototypes, making changes to tools, materials, and procedures as needed • Record **iterations** of prototyping	*Students are expected to know the following:* • **mechanical systems** • alternating current (AC) and direct current (DC) **electronic systems** • **electromechanics** • **computer control systems** • drafting, drawing, and design using computer-aided design (CAD) and computer-aided manufacturing (CAM) • programmable logic controllers, processors, and microcontrollers • displays, interfaces, and instrumentation • **hydraulic and pneumatic systems** • repeatability and load capacity • **industrial applications** of mechatronics

Learning Standards (continued)

Curricular Competencies	Content
Testing • Identify feedback most needed and possible **sources of that feedback** • Develop an **appropriate test** of the prototype • Gather feedback from users over time to critically evaluate their design and make changes to product design or processes • Iterate the prototype or abandon the design idea *Making* • Identify appropriate tools, technologies, materials, processes, **potential funding sources**, and time needed for production, and where/how these could be available • Use project management processes when working individually or collaboratively to coordinate production *Sharing* • **Share** their progress while making to increase feedback, collaboration, and, if applicable, marketing • Decide on how and with whom to share or promote their **product**, creativity, and, if applicable, intellectual property • Critically evaluate their design thinking and processes, and their ability to work effectively both as individuals and collaboratively in a group, including the ability to implement project management processes • Identify new design issues, including how they or others might build on their concept **Applied Skills** • Demonstrate an awareness of safety issues for themselves, co-workers, and users in both physical and digital environments • Identify and evaluate their skills and skill levels, in relation to their project or design interests, and develop specific plans to learn or refine their skills over time **Applied Technologies** • Explore existing, new, and emerging tools, **technologies**, and systems and evaluate their suitability for their design interests • Analyze the role and impact of technologies in societal change, and the personal, social, and environmental impacts, including unintended negative consequences, of their choices of technology use • Analyze how cultural beliefs, values, and ethical positions affect the development and use of technologies	

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Learning Standards (continued)

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Big Ideas – Elaborations

- **designed for life cycle:** taking into account in the design process, economic costs, and social and environmental impacts of the product, from the extraction of raw materials to eventual reuse or recycling of component materials

APPLIED DESIGN, SKILLS, AND TECHNOLOGIES – Mechatronics
Grade 12

Curricular Competencies – Elaborations

- **user-centred research:** research done directly with potential users to understand how they do things and why, their physical and emotional needs, how they think about the world, and what is meaningful to them
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- **boundaries:** limiting factors, such as available technology, expense, environmental impact, issues of appropriation, and knowledge that is considered sacred
- **Ideating:** forming ideas or concepts
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- **information:** for example, other people as experts (e.g., First Peoples Elders), secondary sources, collective pools of knowledge in communities, collaborative atmospheres
- **design for life cycle:** including the social and environmental impacts of extraction and transportation of raw materials, manufacturing, packaging, transportation to markets, servicing or providing replacement parts, expected usable lifetime, and reuse or recycling of component materials
- **iterations:** repetitions of a process with the aim of approaching a desired result
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- **appropriate test:** includes evaluating the degree of authenticity required for the setting of the test, deciding on an appropriate type and number of trials, and collecting and compiling data
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- **share:** may include showing to others, use by others, giving away, or marketing and selling
- **product:** for example, a physical product, a process, a system, a service, or a designed environment
- **technologies:** things that extend human capabilities

Content – Elaborations

- **mechanical systems:** for example, structures, mechanical motion devices, gears, pulleys, levers
- **electronic systems:** for example, sensors, limit switches, gyroscopes, accelerometers, potentiometers, range finders
- **electromechanics:** electrical devices that perform mechanical functions; for example, linear actuators and motors
- **computer control systems:** manage commands and regulate other devices or systems
- **hydraulic and pneumatic system:** for example, pumps and valves, accumulators, pressure regulators
- **industrial applications:** for example, medical, automotive, aerospace, manufacturing, technologies for people with physical dependencies

BIG IDEAS

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Learning Standards

Curricular Competencies	Content
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Learning Standards (continued)

Curricular Competencies	Content
Testing • Identify feedback most needed and possible **sources of that feedback** • Develop an **appropriate test** of the prototype • Gather feedback from users over time to critically evaluate their design and make changes to product design or processes • Iterate the prototype or abandon the design idea *Making* • Identify appropriate tools, technologies, materials, processes, **potential funding sources**, and time needed for production, and where/how these could be available • Use project management processes when working individually or collaboratively to coordinate production *Sharing* • **Share** their progress while making to increase feedback, collaboration, and, if applicable, marketing • Decide on how and with whom to share or promote their **product**, creativity, and, if applicable, intellectual property • Critically evaluate their design thinking and processes, and their ability to work effectively both as individuals and collaboratively in a group, including the ability to implement project management processes • Identify new design issues, including how they or others might build on their concept **Applied Skills** • Demonstrate an awareness of safety issues for themselves, co-workers, and users in both physical and digital environments • Identify and evaluate their skills and skill levels, in relation to their project or design interests, and develop specific plans to learn or refine their skills over time **Applied Technologies** • Explore existing, new, and emerging tools, **technologies**, and systems and evaluate their suitability for their design interests • Analyze the role and impact of technologies in societal change, and the personal, social, and environmental impacts, including unintended negative consequences, of their choices of technology use • Analyze how cultural beliefs, values, and ethical positions affect the development and use of technologies	

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Learning Standards (continued)

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Big Ideas – Elaborations

- **designed for life cycle:** taking into account in the design process, economic costs, and social and environmental impacts of the product, from the extraction of raw materials to eventual reuse or recycling of component materials

APPLIED DESIGN, SKILLS, AND TECHNOLOGIES – Metalwork
Grade 12

Curricular Competencies – Elaborations

- **user-centred research:** research done directly with potential users to understand how they do things and why, their physical and emotional needs, how they think about the world, and what is meaningful to them
- **Defining:** setting parameters
- **boundaries:** limiting factors, such as available technology, expense, environmental impact, issues of appropriation, and knowledge that is considered sacred
- **Ideating:** forming ideas or concepts
- **designing with users:** working with users at all stages of the design process
- **sources of inspiration:** may include experiences; traditional cultural knowledge and approaches, including those of First Peoples; places, including the land and its natural resources and analogous settings; and people, including users, experts, and thought leaders
- **information:** for example, other people as experts (e.g., First Peoples Elders), secondary sources, collective pools of knowledge in communities, collaborative atmospheres
- **design for life cycle:** including the social and environmental impacts of extraction and transportation of raw materials, manufacturing, packaging, transportation to markets, servicing or providing replacement parts, expected usable lifetime, and reuse or recycling of component materials
- **iterations:** repetitions of a process with the aim of approaching a desired result
- **sources of that feedback:** may include peers; users; keepers of traditional cultural knowledge and approaches, including those of First Peoples; and other experts
- **appropriate test:** includes evaluating the degree of authenticity required for the setting of the test, deciding on an appropriate type and number of trials, and collecting and compiling data
- **potential funding sources:** It is not the intent, and not appropriate, for students to have to raise funds in order to complete their school project. Students may, however, wish to investigate sources of funding for the commercial development of their products.
- **share:** may include showing to others, use by others, giving away, or marketing and selling
- **product:** for example, a physical product, a process, a system, a service, or a designed environment
- **technologies:** things that extend human capabilities

Content – Elaborations

- **methods:** lost wax, sand, investment
- **related material:** for example, glass, plastic, wood, motors, wheels, bearings
- **finishing:** for example, paint, powder coat, clear coat
- **maintenance, and adjustment:** for example, changing blades, bits, blade types, feeds, speeds, and positions of guards
- **specialization:** for example, welding, machining, art metalworking, jewellery, fabrication

BIG IDEAS

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Learning Standards

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Learning Standards (continued)

Curricular Competencies	Content
Testing • Identify feedback most needed and possible **sources of that feedback** • Develop an **appropriate test** of the prototype • Gather feedback from users over time to critically evaluate their design and make changes to product design or processes • Iterate the prototype or abandon the design idea *Making* • Identify appropriate tools, technologies, materials, processes, **potential funding sources**, and time needed for production, and where/how these could be available • Use project management processes when working individually or collaboratively to coordinate production *Sharing* • **Share** their progress while making to increase feedback, collaboration, and, if applicable, marketing • Decide on how and with whom to share or promote their **product**, creativity, and, if applicable, intellectual property • Critically evaluate their design thinking and processes, and their ability to work effectively both as individuals and collaboratively in a group, including the ability to implement project management processes • Identify new design issues, including how they or others might build on their concept **Applied Skills** • Demonstrate an awareness of safety issues for themselves, co-workers, and users in both physical and digital environments • Identify and evaluate their skills and skill levels, in relation to their project or design interests, and develop specific plans to learn or refine their skills over time **Applied Technologies** • Explore existing, new, and emerging tools, **technologies**, and systems and evaluate their suitability for their design interests • Analyze the role and impact of technologies in societal change, and the personal, social, and environmental impacts, including unintended negative consequences, of their choices of technology use • Analyze how cultural beliefs, values, and ethical positions affect the development and use of technologies	

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Learning Standards (continued)

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Big Ideas – Elaborations

- **designed for life cycle:** taking into account in the design process, economic costs, and social and environmental impacts of the product, from the extraction of raw materials to eventual reuse or recycling of component materials

APPLIED DESIGN, SKILLS, AND TECHNOLOGIES – Robotics
Grade 12

Curricular Competencies – Elaborations

- **user-centred research:** research done directly with potential users to understand how they do things and why, their physical and emotional needs, how they think about the world, and what is meaningful to them
- **Defining:** setting parameters
- **boundaries:** limiting factors, such as available technology, expense, environmental impact, issues of appropriation, and knowledge that is considered sacred
- **Ideating:** forming ideas or concepts
- **designing with users:** working with users at all stages of the design process
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- **sources of that feedback:** may include peers; users; keepers of traditional cultural knowledge and approaches, including those of First Peoples; and other experts
- **appropriate test:** includes evaluating the degree of authenticity required for the setting of the test, deciding on an appropriate type and number of trials, and collecting and compiling data
- **potential funding sources:** It is not the intent, and not appropriate, for students to have to raise funds in order to complete their school project. Students may, however, wish to investigate sources of funding for the commercial development of their products.
- **share:** may include showing to others, use by others, giving away, or marketing and selling
- **product:** for example, a physical product, a process, a system, a service, or a designed environment
- **technologies:** things that extend human capabilities

Content – Elaborations

- **sensors:** for example, encoders, gyroscopic, accelerometers
- **feedback loops:** for example, position control, speed control, distance measurement; bang-bang versus proportional integral derivative (PID)
- **protocols:** serial, and pulse-width modulation (PWN)
- **battery technology:** for example, nickel-cadmium (NiCd), nickel–metal hydride (NiMH), lead-acid, lithium-ion (Li-ion), lithium-ion polymer
- **wireless communication options:** Wi-Fi, Bluetooth, and infrared
- **wiring and cabling:** for example, routing, connections, strain relief, flexibility

BIG IDEAS

Products can be **designed for life cycle**.	Personal design interests require the evaluation and refinement of skills.	Tools and technologies can be adapted for specific purposes.

Learning Standards

Curricular Competencies	Content
Students are expected to be able to do the following: **Applied Design** *Understanding context* • Conduct **user-centred research** to understand design opportunities and barriers ***Defining*** • Choose a design opportunity and point of view • Identify potential users, intended impact, and possible unintended negative consequences • Make inferences about premises and **boundaries** that define the design space ***Ideating*** • Take creative risks to identify gaps to explore as design space • Generate ideas to create a range of possibilities and add to others' ideas in ways that create additional possibilities • Critically analyze how competing social, ethical, and sustainability considerations impact designed solutions to meet global needs for preferred futures • Prioritize ideas for prototyping and **designing with users** *Prototyping* • Identify and use a variety of **sources of inspiration** and **information** • Choose an appropriate form, scale, and level of detail for prototyping, and plan procedures for prototyping multiple ideas • Analyze the **design for life cycle** • Construct prototypes, making changes to tools, materials, and procedures as needed • Record **iterations** of prototyping	*Students are expected to know the following:* • creation and/or use of working pictorial and written plans • **wood-related materials** • selection of wood based on its **properties** • layout and use of materials to minimize waste and conserve material • operation, **maintenance, and adjustment** of stationary power equipment • woodworking **joinery** • analysis and identification of defects in wood • methods for preparing wood surfaces for application of finish • identification and analysis of building codes for applicable projects • sequence of steps when working with power equipment • **sharpening procedures** • **purposes** of finishes • **application** of finishes

Learning Standards (continued)

Curricular Competencies	Content
Testing • Identify feedback most needed and possible **sources of that feedback** • Develop an **appropriate test** of the prototype • Gather feedback from users over time to critically evaluate their design and make changes to product design or processes • Iterate the prototype or abandon the design idea *Making* • Identify appropriate tools, technologies, materials, processes, **potential funding sources**, and time needed for production, and where/how these could be available • Use project management processes when working individually or collaboratively to coordinate production *Sharing* • **Share** their progress while making to increase feedback, collaboration, and, if applicable, marketing • Decide on how and with whom to share or promote their **product**, creativity, and, if applicable, intellectual property • Critically evaluate their design thinking and processes, and their ability to work effectively both as individuals and collaboratively in a group, including the ability to implement project management processes • Identify new design issues, including how they or others might build on their concept **Applied Skills** • Demonstrate an awareness of safety issues for themselves, co-workers, and users in both physical and digital environments • Identify and evaluate their skills and skill levels, in relation to their project or design interests, and develop specific plans to learn or refine their skills over time **Applied Technologies** • Explore existing, new, and emerging tools, **technologies**, and systems and evaluate their suitability for their design interests • Analyze the role and impact of technologies in societal change, and the personal, social, and environmental impacts, including unintended negative consequences, of their choices of technology use • Analyze how cultural beliefs, values, and ethical positions affect the development and use of technologies	

BIG IDEAS

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Big Ideas – Elaborations

- **designed for life cycle:** taking into account in the design process, economic costs, and social and environmental impacts of the product, from the extraction of raw materials to eventual reuse or recycling of component materials

APPLIED DESIGN, SKILLS, AND TECHNOLOGIES – Woodwork
Grade 12

Curricular Competencies – Elaborations

- **user-centred research:** research done directly with potential users to understand how they do things and why, their physical and emotional needs, how they think about the world, and what is meaningful to them
- **Defining:** setting parameters
- **boundaries:** limiting factors, such as available technology, expense, environmental impact, issues of appropriation, and knowledge that is considered sacred
- **Ideating:** forming ideas or concepts
- **designing with users:** working with users at all stages of the design process
- **sources of inspiration:** may include experiences; traditional cultural knowledge and approaches, including those of First Peoples; places, including the land and its natural resources and analogous settings; and people, including users, experts, and thought leaders
- **information:** for example, other people as experts (e.g., First Peoples Elders), secondary sources, collective pools of knowledge in communities, collaborative atmospheres
- **design for life cycle:** including the social and environmental impacts of extraction and transportation of raw materials, manufacturing, packaging, transportation to markets, servicing or providing replacement parts, expected usable lifetime, and reuse or recycling of component materials
- **iterations:** repetitions of a process with the aim of approaching a desired result
- **sources of that feedback:** may include peers; users; keepers of traditional cultural knowledge and approaches, including those of First Peoples; and other experts
- **appropriate test:** includes evaluating the degree of authenticity required for the setting of the test, deciding on an appropriate type and number of trials, and collecting and compiling data
- **potential funding sources:** It is not the intent, and not appropriate, for students to have to raise funds in order to complete their school project. Students may, however, wish to investigate sources of funding for the commercial development of their products.
- **share:** may include showing to others, use by others, giving away, or marketing and selling
- **product:** for example, a physical product, a process, a system, a service, or a designed environment
- **technologies:** things that extend human capabilities

Content – Elaborations

- **wood-related materials:** plywood, oriented strand board (OSB), medium density fiberboard (MDF), composite, and veneer
- **properties:** for example, softwood, hardwood, grain pattern, knots, weathering
- **maintenance, and adjustment:** changing blades, blade heights, blade types, changing bits, feeds, speeds, and positioning guard
- **joinery:** spline, mortise and tenon, biscuit, dovetail, fingers
- **sharpening procedures:** how to test and sharpen
- **purposes:** prevent warping, protect surface
- **application:** for example, oil, stain, clear coat, wax