

## BIG IDEAS

**Design for the life cycle** includes consideration of social and **environmental impacts**.

Personal design interests require the evaluation and refinement of skills.

Tools and **technologies** can be adapted for specific purposes.

## Learning Standards

Curricular Competencies	Content
<p><i>Students are expected to be able to do the following:</i></p> <p><b>Applied Design</b></p> <p><i>Understanding context</i></p> <ul style="list-style-type: none"> <li>Engage in a period of <b>user-centred research</b> and <b>empathetic observation</b> to understand design opportunities</li> </ul> <p><i>Defining</i></p> <ul style="list-style-type: none"> <li>Establish a point of view for a chosen design opportunity</li> <li>Identify potential users, intended impacts, and possible unintended negative consequences</li> <li>Make decisions about premises and <b>constraints</b> that define the design space, and identify criteria for success</li> <li>Determine whether activity is collaborative or self-directed</li> </ul> <p><i>Ideating</i></p> <ul style="list-style-type: none"> <li>Identify and examine gaps for potential design improvements and innovations</li> <li>Critically analyze how competing social, ethical, and sustainability considerations impact creation and development of solutions</li> <li>Generate ideas to create a range of possibilities and add to others' ideas in ways that create additional possibilities</li> <li>Evaluate suitability of possibilities according to success criteria, constraints, and potential gaps, and prioritize for prototyping</li> <li>Work with users throughout the design process</li> </ul>	<p><i>Students are expected to know the following:</i></p> <ul style="list-style-type: none"> <li>design for the life cycle</li> <li><b>mathematics</b> in advanced engineering projects</li> <li><b>measurement techniques</b> in advanced engineering projects</li> <li>advanced static analysis of structures:               <ul style="list-style-type: none"> <li>stress-strain analysis</li> <li>stress analysis software</li> </ul> </li> <li><b>non-destructive testing</b> and destructive testing</li> <li>materials science:               <ul style="list-style-type: none"> <li>metals and alloys (metallurgy)</li> <li>ceramics</li> <li>plastics and polymers</li> <li>composites</li> </ul> </li> <li><b>geometric dimensioning and tolerancing</b></li> <li>vibrations and <b>seismic analysis</b></li> <li>programming languages and applications</li> <li>quality control methods</li> <li><b>physics</b> in advanced engineering projects</li> <li>robotics and robotic manufacturing</li> </ul>

Learning Standards (continued)

Curricular Competencies	Content
<p><b>Prototyping</b></p> <ul style="list-style-type: none"> <li>Choose an appropriate form, scale, and level of detail for prototyping, and plan procedures</li> <li>Analyze the design for the life cycle and evaluate its <b>impacts</b></li> <li>Visualize and construct prototypes, making changes to tools, materials, and procedures as needed</li> <li>Record <b>iterations</b> of prototyping</li> </ul> <p><b>Testing</b></p> <ul style="list-style-type: none"> <li>Identify and communicate with <b>sources of feedback</b></li> <li>Develop an <b>appropriate test</b> of the prototype, conduct the test, and collect and compile data</li> <li>Evaluate design according to critiques, testing results, and success criteria to make changes</li> </ul> <p><b>Making</b></p> <ul style="list-style-type: none"> <li>Identify appropriate tools, technologies, materials, processes, cost implications, and time needed</li> <li>Create design, incorporating feedback from self, others, and results from testing of the prototype</li> <li>Use materials in ways that minimize waste</li> </ul> <p><b>Sharing</b></p> <ul style="list-style-type: none"> <li>Decide how and with whom to <b>share</b> creativity, or share and promote design and processes</li> <li>Share the product with users and critically evaluate its success</li> <li>Critically reflect on plans, products and processes, and identify new design goals</li> <li>Evaluate new possibilities for plans, products and processes, including how they or others might build on them</li> </ul> <p><b>Applied Skills</b></p> <ul style="list-style-type: none"> <li>Apply safety procedures for themselves, co-workers, and users in both physical and digital environments</li> </ul>	<ul style="list-style-type: none"> <li>future career options and opportunities in engineering, including design, production, and emerging applications</li> <li><b>interpersonal and consultation skills</b> for interacting with colleagues and clients</li> </ul>

**Learning Standards (continued)**

Curricular Competencies	Content
<ul style="list-style-type: none"> <li>• Individually or collaboratively identify and assess skills needed for design interests</li> <li>• Demonstrate competency and proficiency in skills at various levels involving manual dexterity</li> <li>• Develop specific plans to learn or refine identified skills over time</li> </ul> <p><b>Applied Technologies</b></p> <ul style="list-style-type: none"> <li>• Explore existing, new, and emerging tools, technologies, and systems to evaluate suitability for design interests</li> <li>• Evaluate impacts, including unintended negative consequences, of choices made about technology use</li> <li>• Analyze the role that changing technologies play in multiple engineering contexts</li> </ul>	