# iSTEM – Computer-aided design (CAD)



Contents

[Computer-aided design 2](#_Toc126676945)

[Duration of learning 2](#_Toc126676946)

[Outcomes 2](#_Toc126676947)

[Rationale 3](#_Toc126676948)

[Aim 5](#_Toc126676949)

[Purpose and audience 5](#_Toc126676950)

[When and how to use this document 5](#_Toc126676951)

[Learning sequences 6](#_Toc126676952)

[Weeks 1 and 2 7](#_Toc126676953)

[Weeks 3 and 4 15](#_Toc126676954)

[Weeks 5 and 6 21](#_Toc126676955)

[Weeks 7 and 8 25](#_Toc126676956)

[Weeks 9 and 10 33](#_Toc126676957)

[Reflection and evaluation 37](#_Toc126676958)

[Additional information 38](#_Toc126676959)

[Assessment for learning 38](#_Toc126676960)

[Differentiation 39](#_Toc126676961)

[About this resource 40](#_Toc126676962)

[References 43](#_Toc126676963)

## Computer-aided design

Technological advancements in manufacturing combined with innovations in 3D modelling software have created an evolving need for a workforce with computer-aided design skills. Knowledge of the engineering design process, problem solving, creativity and collaboration have been identified as important skills that are required in this rapidly advancing field.

In this elective topic students develop skills in computer-aided design (CAD) with an emphasis on 3D modelling. Practical activities prepare students to develop skills in rapid prototyping, including additive and subtractive manufacturing. Students should be able to competently use CAD skills and 3D modelling to create, test and present solutions to real-world problems.

Students develop future focused employment skills which complement the development of solutions in specialised topics.

### Duration of learning

Indicative time – 25 hours.

### Outcomes

A student:

* **ST5-1** designs and develops creative, innovative, and enterprising solutions to a wide range of STEM-based problems
* **ST5-2** demonstrates critical thinking, creativity, problem solving, entrepreneurship and engineering design skills and decision-making techniques in a range of STEM contexts
* **ST5-3** applies engineering design processes to address real-world STEM-based problems
* **ST5-4** works independently and collaboratively to produce practical solutions to real-world scenarios
* **ST5-5** analyses a range of contexts and applies STEM principles and processes
* **ST5-6** selects and safely uses a range of technologies in the development, evaluation, and presentation of solutions to STEM-based problems
* **ST5-7** selects and applies project management strategies when developing and evaluating STEM-based design solutions
* **ST5-8** uses a range of techniques and technologies, to communicate design solutions and technical information for a range of audiences
* **ST5-9** collects, organises, and interprets data sets, using appropriate mathematical and statistical methods to inform and evaluate design decisions
* **ST5-10** analyses and evaluates the impact of STEM on society and describes the scope and pathways into employment.

Outcomes referred to in this document are from the [iSTEM course document](https://education.nsw.gov.au/teaching-and-learning/curriculum/department-approved-courses/istem#/asset2) © NSW Department of Education for and on behalf of the crown in the State of New South Wales (2021).

### Rationale

Australian businesses competing in a global economy will need more employees trained in science, technology, engineering, and mathematics (STEM). Research indicates that 75% of the fastest-growing occupations require STEM skills. Global accounting firm PwC (formerly known as PricewaterhouseCoopers) produced a report titled ‘[A smart move](https://www.pwc.com.au/publications/a-smart-move.html)’ where it found that shifting just 1% of the Australian workforce into STEM roles would add $57.4 billion to the gross domestic product (GDP) (net present value over 20 years).

iSTEM is a student-centred Stage 5 elective course that delivers science, technology, engineering, and mathematics education in an interdisciplinary, innovative, and integrated fashion. It was developed in direct response to industry’s urgent demand for young people skilled in science, technology, engineering, and mathematics.

The course was developed in collaboration with, and is supported by, industry, business, government, and universities, ensuring that students develop future-focused STEM skills. The course has a number of specialised topics, many of which are aligned with NSW State Government priority industries, identified in the [NSW Industry Development Framework](https://www.investment.nsw.gov.au/living-working-and-business/nsw-industry-development-framework/).

iSTEM develops enabling skills and knowledge that increasingly underpin many professions and trades, and the skills of a technologically enabled workforce. It provides students with learning opportunities to develop knowledge and skills to use the most up-to-date technologies including additive manufacturing (3D printing), laser cutters, augmented and virtual reality, drones, smart robotics and automation systems, artificial intelligence (AI) and a range of digital systems.

Students gain and apply knowledge, deepen their understanding, and develop collaborative, creative and critical thinking skills within authentic, real-world contexts. The course uses inquiry, problem and project-based learning approaches to solve problems and produce practical solutions utilising engineering design processes.

iSTEM is aligned to the concept of ‘[Industry 4.0](https://www.weforum.org/agenda/2019/01/why-companies-should-strive-for-industry-4-0/)’ which refers to a new and emerging phase in the industrial revolution that heavily focuses on interconnectivity, automation, machine learning and real-time data.

iSTEM has been developed to meet the goals of National Federation Reform Council (NFRC) Education Council’s [National STEM School Education Strategy (2016-2026)](https://www.dese.gov.au/education-ministers-meeting/resources/national-stem-school-education-strategy), and supports the NSW Government’s [NSW Industry Development Framework](https://www.investment.nsw.gov.au/living-working-and-business/nsw-industry-development-framework/), the NSW Department of Education’s [Rural and Remote Education Strategy (2021-2024)](https://education.nsw.gov.au/about-us/strategies-and-reports/rural-and-remote-education-strategy-2021-24) and the [High Potential and Gifted Education policy](https://education.nsw.gov.au/policy-library/policies/pd-2004-0051).

### Aim

The aim of the course is to engage and encourage student interest and skills in STEM, appreciate the scope, impact and pathways into STEM careers and learn how to work collaboratively, entrepreneurially, and innovatively to solve real-world problems.

### Purpose and audience

This teaching resource is for teachers delivering or planning to deliver the course. The learning sequence demonstrates how a combination of outcomes can be used to develop teaching and learning activities. It also suggests a range of resources to support teachers when planning and/or teaching the course.

### When and how to use this document

Use this resource when designing learning activities that align with the course outcomes and content. The activities and resources can be used directly or may be adapted based on teacher judgment and knowledge of their students. Consult the course document for further details on sequencing core, elective and specialised topics.

## Learning sequences

This sample learning sequence has been prepared by the NSW Department of Education. It has been developed as a guide for teachers to assist in the development of a teaching and learning program contextualised to an individual school's needs. The scope and depth of the content covered should relate to the school's context, expertise of the teachers delivering the course and the prior knowledge of the students. Plan learning activities that are inclusive and accommodate the needs of all students, in your classroom from the beginning. Some students may require more specific adjustments to allow them to participate on the same basis. Space is provided for adjustments and enhancements that are made to the learning sequence during its implementation, in order to meet the individual needs of students and to allow for differentiation of the iSTEM curriculum. For further advice, see [Additional information](#_Additional_information) later in this document.

### Weeks 1 and 2

Table 1 – Computer-aided design weeks 1 and 2 learning sequence

|  |  |  |  |
| --- | --- | --- | --- |
| Outcomes and content | Teaching and learning | Evidence of learning | Adjustments and registration |
| **Week 1 – Introduction**  **ST5-4, ST5-8**  Students:   * explore 3D coordinate geometry. | **Teacher**  Introduce computer-aided design (CAD) topic.  Outline the scope of professions that use CAD.  Demonstrate the principles of technical drawing, including 2-dimensional (2D) and 3-dimensional (3D) representations of basic objects, for example:   * isometric projections * orthographic projections.   Demonstrate use of technical drawing tools, for example:   * drawing boards * set squares * isometric templates.   **Students**  Produce a simple 2-dimensional (2D) and a 3-dimensional (3D) drawing using traditional technical drawing techniques, for example:   * sketches on isometric grid * completing orthographic projections. | Students will have commenced producing a portfolio of traditional technical drawings that demonstrates a range of drawings and techniques. | (Add adjustments and registration) |
| **ST5-4, ST5-8**  Students:   * explore 3D coordinate geometry * outline the historical perspectives that have led to the development of CAD. | **Teacher**  Demonstrate additional isometric drawing techniques.  Briefly outline [A Walk Through the History of CAD (4:15)](https://www.youtube.com/watch?v=mcwIMsh_g3o)  **Students**  Practise traditional technical drawing techniques, including sketching, isometric views and orthographic projections. | Students continue to contribute to their portfolio of traditional technical drawings.  Students should be able to describe the key features of isometric and orthographic projections. | (Add adjustments and registration) |
| **ST5-6**  Students:   * compare the benefits of CAD systems with traditional drawing methods. | **Teacher**  Outline the CAD software that will be used, including capabilities and any necessary technical requirements, for example:   * licensing * logon credentials * operating system * type of computing device required * 3-button mouse.   Provide information to students to access CAD software at home.  Compare advantages and disadvantages of native CAD application software with online cloud-based CAD software.  Demonstrate how to start chosen CAD software and then assist students to get software started.  **Students**  Open CAD software and become acquainted with user interface and basic functions.  Compare the processes of creating 3-dimensional representations in both traditional drawing and CAD environments. | Students produce simple 2-dimensional (2D) and 3-dimensional (3D) drawings using a CAD application that contribute to students’ portfolio of work.  Students should be able to identify key features of a selected CAD software package.  Students should be able to describe the advantages of the chosen CAD software application and compare 3-dimensional (3D) drawing processes. | Consider accessibility needs and check for built-in features when using selected CAD software and hardware. |
| **Weekly reflection** | **Teacher**  Explain purpose of weekly reflection.  Demonstrate how to complete a weekly reflection using a procedural recount text type.  **Students**  Assess what they know, what they need to know and how they might bridge any gap in understanding that exists.  Complete weekly reflection using school-based template or learning platform. | Students will be able to record their key learning events or activities using a procedural recount text type.  Students will demonstrate the impact of these learning events or activities by making judgments about what has happened and what they still need to understand. | Procedural recount to be prepared on paper or digitally, including speech-to-text or voice recording. |
| **Week 2 – Basic part modelling**  **ST5-6**  Students:   * describe a range of CAD concepts * explore 3D coordinate geometry * use a range of CAD software functions * use a range of CAD (3D modelling) techniques * create and modify 3D models of simple and complex shapes. | **Teacher**  Outline the roles of CAD within advanced manufacturing, for example:   * modelling parts that match real-life constraints * create models for parts that are manufacture ready.   Explain key aspects of the user interface and introduce basic functions of CAD software.  Demonstrate 3D coordinate geometry concepts used in modern CAD software.  Demonstrate the following:   * changing or adjusting views * selecting or creating work planes * sketching (on planes) * extruding.   **Students**  Explore how CAD tools can be used in the design process.  Complete the CAD activities demonstrated by teacher. | Students use a CAD application to produce drawings that contribute to a portfolio of work.  Students will be able to recall different applications of CAD in advanced manufacturing. | Consider accessibility needs and check for built-in features when using selected CAD software and hardware. |
| **ST5-6**  Students:   * describe a range of CAD concepts * explore 3D coordinate geometry * use a range of CAD software functions * use a range of CAD (3D modelling) techniques * create and modify 3D models of simple and complex shapes. | **Teacher**  Demonstrate the following:   * editing sketches and features * creating a revolve * construction lines * circles.   **Students**  Complete the CAD activities demonstrated by teacher. | Students produce drawings using a CAD application that contributes to a portfolio of CAD drawings. | (Add adjustments and registration) |
| **Weekly reflection** | **Students**  Assess what they know, what they need to know, and how they might bridge any gap in understanding that exists.  Complete weekly reflection using school-based template or learning platform. | Students will be able to record their key learning events or activities using a procedural recount text type.  Students will demonstrate the impact of these learning events or activities by making judgments about what has happened and what they still need to understand. | Procedural recount to be prepared on paper or digitally, including speech-to-text or voice recording. |

### Weeks 3 and 4

Table 2 – Computer-aided design weeks 3 and 4 learning sequence

|  |  |  |  |
| --- | --- | --- | --- |
| Outcomes and content | Teaching and learning | Evidence of learning | Adjustments and registration |
| **Week 3 – Creating parts**  **ST5-4, ST5-6**  Students:   * use a range of CAD software functions * use a range of CAD (3D modelling) techniques * create and modify 3D models of simple and complex shapes * explore 3D coordinate geometry. | **Teacher**  Outline the drawing project and describe the list of parts to be modelled.  Demonstrate correct procedure to create a part according to project specifications using selected CAD software.  Identify relevant tools to create features, for example:   * line and arc tools * construction lines.   **Students**  Complete the CAD activities demonstrated by teacher. | Students have created parts to the same dimensions as the teacher (or required specifications).  Students are able to transfer application of skills to new situations, for example:   * modifying scale or dimensions * remixing design attributes.   Students contribute to a portfolio of design drawings. | Consider accessibility needs and check for built-in features when using selected CAD software and hardware. |
| **ST5-4, ST5-6**  Students:   * use a range of CAD software functions * use a range of CAD (3D modelling) techniques * create and modify 3D models of simple and complex shapes * explore 3D coordinate geometry. | **Teacher**  Demonstrate correct procedure to create a part according to project specifications using selected CAD software.  Demonstrate how to import parts or assemblies from an online repository, for example:   * [GrabCAD](https://grabcad.com/library) * [McMaster-Carr](https://www.mcmaster.com/).   **Students**  Complete the CAD activities demonstrated by teacher.  Identify suitable parts or assemblies and import using selected CAD software. | Students have documented design solution sketches.  Students have constructed a physical design solution that resembles a design sketch.  Students document the results of testing the design solution against success criteria.  Students contribute to a portfolio of design drawings. | Consider accessibility needs and check for built-in features when using selected CAD software and hardware. |
| **ST5-8**  Students:   * describe the relationship between different drawing standards * **configure CAD software to set up preferences and produce drawings that meet AS 1100 standards.** | **Teacher**  Introduce Australian standard AS 1100 and distinguish from international standards, for example:   * International Organization for Standardization (ISO) * American National Standards Institute (ANSI).   Outline how AS 1100 standards define every aspect of engineering drawings to communicate industrial designs and technical specifications consistently and without ambiguity.  Demonstrate how to configure CAD software to apply AS 1100 standards and how the settings are reflected in drawings, for example, units.  **Students**  Configure CAD software to use AS 1100 settings and confirm by creating a simple sketch using correct units. | Students should be able to recall AS 1100 standards as the set of Australian standards for technical drawing and identify a range of aspects the standards define, for example:   * units * title blocks * dimensioning * line types.   Students contribute to a portfolio of design drawings. | (Add adjustments and registration) |
| **Weekly reflection** | **Students**  Complete weekly reflection using school-based template or learning platform. | Students demonstrate critical thinking and skills in using procedural recount text types in the production of a weekly reflection document. | Procedural recount to be prepared on paper or digitally, including speech-to-text or voice recording. |
| **Week 4**  **ST5-4, ST5-6**  Students:   * use a range of CAD software functions * use a range of CAD (3D modelling) techniques * create and modify 3D models of simple and complex shapes * explore 3D coordinate geometry. | **Teacher**  Demonstrate correct procedure to create a part according to project specifications using selected CAD software.  Identify relevant tools to create features, for example:   * line and arc tools * construction lines.   Demonstrate how to use constraints to create required geometry.  **Students**  Complete the CAD activities demonstrated by teacher using the selected CAD software. | Students contribute to a portfolio of design drawings. | (Add adjustments and registration) |
| **ST5-4, ST5-6**  Students:   * use a range of CAD software functions * use a range of CAD (3D modelling) techniques * create and modify 3D models of simple and complex shapes * explore 3D coordinate geometry. | **Teacher**  Introduce common CAD file types and common applications, for example:   * DXF * OBJ * STL.   **Students**  Identify and select appropriate file types for saving and exporting CAD files to other applications. | Students can describe common CAD file types and their purpose.  Students can demonstrate saving and exporting CAD drawings in other file types. | (Add adjustments and registration) |
| **Weekly reflection** | **Students**  Assess what they know, what they need to know, and how they might bridge any gap in understanding that exists.  Complete weekly reflection using school-based template or learning platform. | Students will be able to record their key learning events or activities using a procedural recount text type.  Students will demonstrate the impact of these learning events or activities by making judgments about what has happened and what they still need to understand. | Procedural recount to be prepared on paper or digitally, including speech-to-text or voice recording. |

### Weeks 5 and 6

Table 3 – Computer-aided design weeks 5 and 6 learning sequence

|  |  |  |  |
| --- | --- | --- | --- |
| Outcomes and content | Teaching and learning | Evidence of learning | Adjustments and registration |
| **Week 5**  **ST5-4, ST5-6**  Students:   * use a range of CAD software functions * use a range of CAD (3D modelling) techniques * create and modify 3D models of simple and complex shapes * explore 3D coordinate geometry. | **Teacher**  Demonstrate correct procedure to create a part according to project specifications using selected CAD software.  **Students**  Complete the CAD activities demonstrated by teacher using the selected CAD software. | [insert evidence of learning] | (Add adjustments and registration) |
| **Weekly reflection** | **Students**  Assess what they know, what they need to know, and how they might bridge any gap in understanding that exists.  Complete weekly reflection using school-based template or learning platform. | Students will be able to record their key learning events or activities using a procedural recount text type.  Students will demonstrate the impact of these learning events or activities by making judgments about what has happened and what they still need to understand. | Procedural recount could be prepared on paper or digitally, including speech-to-text or voice recording. |
| **Week 6**  **ST5-6, ST5-8**  Students:   * explore the relationship between CAD applications and advanced manufacturing * describe features of a CAD (3D modelling) package that are used to assist designers * identify CAD (3D modelling) representations and techniques. | **Teacher**  Introduce computer-aided manufacturing (CAM) and advanced manufacturing concepts.  Explain how CAD is required to produce computer manufactured items.  Introduce CAD rendering and visualisation techniques.  Demonstrate software tools and techniques for rendering presentation drawings. | Students can recognise the link between CAD applications and CAM and advanced manufacturing. | (Add adjustments and registration) |
| **ST5-8**  Students:   * describe features of a CAD (3D modelling) package that are used to assist designers * identify CAD (3D modelling) representations and techniques. | **Teacher**  Demonstrate software tools and techniques for enhancing presentation drawings, for example:   * advanced lighting techniques * photorealistic images * walkthrough animations.   **Students**  Complete the CAD rendering and visualisation activities demonstrated by teacher using the selected CAD software. | [insert evidence of learning] | (Add adjustments and registration) |
| **Weekly reflection** | **Students**  Assess what they know, what they need to know, and how they might bridge any gap in understanding that exists.  Complete weekly reflection using school-based template or learning platform. | Students will be able to record their key learning events or activities using a procedural recount text type.  Students will demonstrate the impact of these learning events or activities by making judgments about what has happened and what they still need to understand. | Procedural recount could be prepared on paper or digitally, including speech-to-text or voice recording. |

### Weeks 7 and 8

Table 4 – Computer-aided design weeks 7 and 8 learning sequence

|  |  |  |  |
| --- | --- | --- | --- |
| Outcomes and content | Teaching and learning | Evidence of learning | Adjustments and registration |
| **Week 7**  **ST5-8**  Students:   * outline the historical perspectives that have led to the development of CAD * describe features of a CAD (3D modelling) package that are used to assist designers * identify CAD (3D modelling) representations and techniques * explore the relationship between CAD applications and advanced manufacturing. | **Teacher**  Provide summary of skills covered up to this point and classify drawing and modelling techniques within the evolution of engineering drawings to modern CAD.  Discuss the difference between parametric modelling and direct modelling.  Outline other types of modelling, for example:   * wireframing * mesh * surface modelling.   Outline issues in selecting one type of modelling over another.  Introduce examples of product visualisation tools, for example:   * tools within CAD software * add-on modules * specialised software packages. | Students can identify 3D modelling types and can explain their key features and differences.  Students use visualisation techniques in their design challenge and portfolio of work. | (Add adjustments and registration) |
| **ST5-8**  Students:   * outline the historical perspectives that have led to the development of CAD * explore the relationship between CAD applications and advanced manufacturing * utilise CAD simulation and modelling tools. | **Teacher**  Outline reasons to conduct simulations on CAD models and product designs, for example:   * performance under real-world conditions * optimisation of designs * confirming safety specifications are met.   Explain how simulation can predict how a design will work in the real-world.  Outline a range of simulation software tools.  Demonstrate the use of simulations, for example:   * static stress * thermal stress * Finite Element Analysis (FEA).   Outline a range of functions available within simulation tools, for example:   * assigning materials to models * applying loads and constraints * perform analyses. | Students can describe the advantages of conducting simulations in the design and manufacture of products.  Students can explain the value of simulations in terms of:   * improved designs * increased safety * time and overall cost savings * reducing waste.   Students will be able to recall some types of simulations available in CAD software and/or add-on modules.  Students will be able to outline some functions common to CAD simulation tools. | (Add adjustments and registration) |
| **ST5-8**  Students:   * outline the historical perspectives that have led to the development of CAD * describe features of a CAD (3D modelling) package that are used to assist designers * utilise CAD simulation and modelling tools. | **Teacher**  Introduce the emerging technology of generative design and the use of artificial intelligence (AI) in CAD.  **Teacher and students**  Discuss the impacts of generative design and AI on design and manufacturing industries. | Students will engage in classroom discussion and make predictions, for example:   * future workforce * manufacturing methods * design options. | (Add adjustments and registration) |
| **Weekly reflection** | **Students**  Complete weekly reflection using school-based template or learning platform. | Students will be able to record their key learning events or activities using a procedural recount text type.  Students will demonstrate the impact of these learning events or activities by making judgments about what has happened and what they still need to understand. | (Add adjustments and registration) |
| **Week 8**  **ST5-10**  Students:   * investigate the nature of work undertaken and the pathways into professions which utilise CAD skills * engage in industry career development opportunities to gain a deeper knowledge of professions that utilise CAD, develop skills, knowledge and understanding of authentic, real-world problem-solving. | **Teacher**  Present STEM careers with high demand for CAD skills.  Provide students with links to STEM career resources, for example:   * [STEM skills vital for jobs of the future](https://www.thegist.edu.au/students/explore-stem-careers/job-ready-skills/) * [STEM Careers A–Z](https://www.thegist.edu.au/students/quiz-and-careers/careers-a-z/) * [Career education in STEM](https://www.thegist.edu.au/schools/career-advisors/career-education-in-stem/)   Use profiles and video resources to highlight professions and discuss different pathways into careers related to CAD, for example:   * [STEM Careers Profiles to Inspire Your Students](https://www.stem.org.uk/resources/elibrary/resource/36629/stem-careers-profiles-inspire-your-students) * [Careers with STEM profiles](https://careerswithstem.com.au/profiles/#gsc.tab=0)   **Students**  Investigate the nature of work undertaken and the pathways into professions which utilise CAD skills. | Students can identify STEM careers that use CAD skills in their work. | (Add adjustments and registration) |
| **Week 8 – Design challenge**  **ST5-1, ST5-2, ST5-4, ST5-6, ST5-8**  Students:   * use a range of CAD software functions * use a range of CAD (3D modelling) techniques * create and modify 3D models of simple and complex shapes * utilise CAD software to communicate design ideas using multiple techniques * use CAD (3D modelling) and rendering techniques to develop solutions to real-world problems * incorporate quality CAD drawings produced from 3D modelling into engineering reports and presentations * work individually and collaboratively, applying engineering design processes to create, analyse and iterate CAD (3D modelling) solutions. | **Teacher**  Select class appropriate design challenge, for example:   * curated list of options * student choice.   Options could include:   * design an assistive technology device * combine 2 everyday objects into a new functional device * modified design of skateboard   Provide students with design challenge.  Revise the iSTEM process introduced in STEM Fundamentals and specify the required iSTEM processes for this challenge.  Model the setup of a digital portfolio to record progress and communicate the final solution.  **Students**  Set up digital portfolio using required selected headings from the iSTEM process.  Apply a shortened engineering design process to address a real-world problem. | [insert evidence of learning] | Teacher to consider accessibility options when using the CAD software.  Provide students with different design challenge options and/or negotiate the requirements of the task with appropriate adjustments.  Advanced students could be encouraged to research advanced techniques and seek out additional tutorials.  Work in teams or individually to complete design challenge. |
| **Weekly reflection** | **Student**  Assess what they know, what they need to know, and how they might bridge any gap in understanding that exists.  Complete weekly reflection using school-based template or learning platform. | Students will be able to record their key learning events or activities using a procedural recount text type.  Students will demonstrate the impact of these learning events or activities by making judgments about what has happened and what they still need to understand. | (Add adjustments and registration) |

### Weeks 9 and 10

Table 5 – Computer-aided design weeks 9 and 10 learning sequence

|  |  |  |  |
| --- | --- | --- | --- |
| Outcomes and content | Teaching and learning | Evidence of learning | Adjustments and registration |
| **Week 9 – Design challenge**  **ST5-1, ST5-2, ST5-4, ST5-6, ST5-8**  Students:   * create and modify 3D models of simple and complex shapes * utilise CAD software to communicate design ideas using multiple techniques * generating orthogonal drawings of modelled parts and assemblies appropriate for manufacturing * use CAD (3D modelling) and rendering techniques to develop solutions to real-world problems * incorporate quality CAD drawings produced from 3D modelling into engineering reports and presentations * work individually and collaboratively, applying engineering design processes to create, analyse and iterate CAD (3D modelling) solutions. | **Teacher**  Facilitate self-directed learning and monitor progress of individuals and/or groups of students.  Provide guidance to assist students with challenging techniques and/or suggest strategies to resolve design problems.  **Student**  Continue with design challenge task documenting key steps in the development of a solution.  Research and document solutions to design problems including online tutorials. | Students complete work on a design.  Students will have produced some CAD drawings, which could include:   * isometric views * orthographic projections with dimensions. | (Add adjustments and registration) |
| **Week 10 – Design challenge**  **ST5-1, ST5-2, ST5-4, ST5-6, ST5-8**  Students:   * create and modify 3D models of simple and complex shapes * utilise CAD software to communicate design ideas using multiple techniques * use CAD (3D modelling) and rendering techniques to develop solutions to real-world problems * incorporate quality CAD drawings produced from 3D modelling into engineering reports and presentations. | **Teacher**  Continue to facilitate self-directed learning and monitor progress of individuals and/or groups of students.  Provide guidance to assist students with challenging techniques and/or suggest strategies to resolve design problems.  **Students**  Continue with design challenge task documenting key steps in the development of a solution.  Research and document solutions to design problems including online tutorials.  Present finished designs. | Students will have produced a variety of CAD drawings to effectively communicate design solutions, which could include:   * orthographic projections with dimensions * isometric views * exploded views * photorealistic views.   Students will have produced an electronic portfolio of CAD drawings demonstrating the development of their design ideas.  Students able to critically evaluate a design solution against a set of quality criteria.  Students demonstrate how they have evaluated the design solution against success criteria with clear and precise statements.  Students are able to verbally explain their progression through the iSTEM process and the features of their design solution. | (Add adjustments and registration) |
| **Weekly reflection** | **Teacher**  Assess progress of student knowledge and skills from reflections.  **Students**  Assess what they know, what they need to know, and how they might bridge any gap in understanding that exists.  Complete weekly reflection using school-based template or learning platform. | Students will be able to record their key learning events or activities using a procedural recount text type.  Students will demonstrate the impact of these learning events or activities by making judgments about what has happened and what they still need to understand. | (Add adjustments and registration) |

## Reflection and evaluation

**Reflecting on and evaluating learning activities should be an ongoing process that happens throughout the delivery of this topic. Teachers should document their evaluation of learning activities throughout the program. The space below is provided to reflect on and evaluate this overall unit of work.**

## Additional information

**Resource evaluation and support**: Please complete the following [feedback form](https://forms.office.com/Pages/ResponsePage.aspx?id=muagBYpBwUecJZOHJhv5kbKo2q_ZUXlHndJMnh2Wd8NUOUk0VTIzUDVVSlVFQVM5MkdOMkJGTjVKNCQlQCN0PWcu) to help us improve our resources and support.

The information below can be used to support teachers when using this teaching resource for iSTEM.

### Assessment for learning

Possible formative assessment strategies that could be included:

* Learning intentions and success criteria assist educators to articulate the purpose of a learning task to make judgements about the quality of student learning. These help students focus on the task or activity taking place and what they are learning and provide a framework for reflection and feedback. [Online tools](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/622) can assist implementation of this formative assessment strategy.
* Eliciting evidence strategies allow teachers to determine the next steps in learning and assist teachers in evaluating the impact of teaching and learning activities. Strategies that may be added to a learning sequence to elicit evidence include all student response systems, [exit tickets](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/543), mini whiteboards (actual or [digital](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/575)), [hinge questions](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/560#.Y9w1CT4W5as.link), [Kahoot](https://app.education.nsw.gov.au/digital-learning-selector/LearningTool/Card/621), [Socrative](https://app.education.nsw.gov.au/digital-learning-selector/LearningTool/Card/587), or quick quizzes to ensure that individual student progress can be monitored and the lesson sequence adjusted based on formative data collected.
* Feedback is designed to close the gap between current and desired performance by informing teacher and student behaviour (AITSL 2017). AITSL provides a [factsheet to support evidence-based feedback](https://www.aitsl.edu.au/teach/improve-practice/feedback#:~:text=FEEDBACK-,Factsheet,-A%20quick%20guide).
* [Peer feedback](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/549) is a structured process where students evaluate the work of their peers by providing valuable feedback in relation to learning intentions and success criteria. It can be supported by [online tools](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Browser?cache_id=1d29b).
* Self-regulated learning opportunities assist students in taking ownership of their own learning. A variety of strategies can be employed and some examples include reflection tasks, [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645), [KWLH charts](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/562), [learning portfolios](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/583) and [learning logs](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/583#.Y9mUe70AtNc.link).

The primary role of assessment is to establish where individuals are in their learning so that teaching can be differentiated and further learning progress can be monitored over time.

Feedback that focuses on improving tasks, processes and student self-regulation is the most effective. Students engaging with feedback can take many forms including formal, informal, formative, summative, interactive, demonstrable, visual, written, verbal and non-verbal.

[What works best update 2020](https://education.nsw.gov.au/about-us/educational-data/cese/publications/research-reports/what-works-best-2020-update) (CESE 2020a)

### Differentiation

Differentiated learning can be enabled by differentiating the teaching approach to content, process, product and the learning environment. For more information on differentiation go to [Differentiating learning](https://education.nsw.gov.au/teaching-and-learning/professional-learning/teacher-quality-and-accreditation/strong-start-great-teachers/refining-practice/differentiating-learning) and [Differentiation](https://education.nsw.gov.au/campaigns/inclusive-practice-hub/secondary-school/teaching-strategies/differentiation).

When using these resources in the classroom, it is important for teachers to consider the needs of all students in their class, including:

* **Aboriginal and Torres Strait Islander students**. Targeted [strategies](https://education.nsw.gov.au/teaching-and-learning/aec/aboriginal-education-in-nsw-public-schools) can be used to achieve outcomes for Aboriginal students in K-12 and increase knowledge and understanding of Aboriginal histories and cultures. Teachers should utilise students’ Personalised Learning Pathways to support individual student needs and goals.
* **EAL/D learners**. EAL/D learners will require explicit English language support and scaffolding, informed by the [EAL/D enhanced teaching and learning cycle](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/resources-for-schools/eald/enhanced-teaching-and-learning-cycle) and the student’s phase on the [EAL/D Learning Progression](https://education.nsw.gov.au/teaching-and-learning/curriculum/multicultural-education/english-as-an-additional-language-or-dialect/planning-eald-support/english-language-proficiency). In addition, teachers can access information about [supporting EAL/D learners](https://education.nsw.gov.au/teaching-and-learning/curriculum/multicultural-education/english-as-an-additional-language-or-dialect/planning-eald-support/english-language-proficiency) and [literacy and numeracy support specific to EAL/D learners](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/resources-for-schools/eald).
* **Students with additional learning needs**. Learning adjustments enable students with disability and additional learning and support needs to access syllabus outcomes and content on the same basis as their peers. Teachers can use a range of [adjustments](https://education.nsw.gov.au/teaching-and-learning/disability-learning-and-support/personalised-support-for-learning/adjustments-to-teaching-and-learning) to ensure a personalised approach to student learning. In addition, the [Universal Design for Learning planning tool](https://education.nsw.gov.au/teaching-and-learning/learning-from-home/teaching-at-home/teaching-and-learning-resources/universal-design-for-learning) can be used to support the diverse learning needs of students using inclusive teaching and learning strategies. Subject specific curriculum considerations can be found on the [Inclusive Practice hub](https://education.nsw.gov.au/campaigns/inclusive-practice-hub).
* **High potential and gifted learners**. [Assessing and identifying high potential and gifted learners](https://education.nsw.gov.au/teaching-and-learning/high-potential-and-gifted-education/supporting-educators/assess-and-identify#Assessment1) will help teachers decide which students may benefit from extension and additional challenge. [Effective strategies and contributors to achievement](https://education.nsw.gov.au/teaching-and-learning/high-potential-and-gifted-education/supporting-educators/evaluate) for high potential and gifted learners help teachers to identify and target areas for growth and improvement. In addition, the [Differentiation Adjustment Tool](https://education.nsw.gov.au/teaching-and-learning/high-potential-and-gifted-education/supporting-educators/implement/differentiation-adjustment-strategies) can be used to support the specific learning needs of high potential and gifted students. The [High Potential and Gifted Education Professional Learning and Resource Hub](https://schoolsnsw.sharepoint.com/sites/HPGEHub/SitePages/Home.aspx) supports school leaders and teachers to effectively implement the High Potential and Gifted Education Policy in their unique contexts.

All students need to be challenged and engaged to develop their potential fully. A culture of high expectations needs to be supported by strategies that both challenge and support student learning needs, such as through appropriate curriculum differentiation. (CESE 2020a:6).

### About this resource

All curriculum resources are prepared through a rigorous process. Resources are periodically reviewed as part of our ongoing evaluation plan to ensure currency, relevance and effectiveness. For additional support or advice contact the Teaching and Learning Curriculum team by emailing [secondaryteachingandlearning@det.nsw.edu.au](mailto:secondaryteachingandlearning@det.nsw.edu.au).

**Alignment to system priorities and/or needs**:

This resource aligns to the School Excellence Framework elements of curriculum (curriculum provision) and effective classroom practice (lesson planning, explicit teaching).

This resource supports teachers to address [Australian Professional Teaching Standards](https://educationstandards.nsw.edu.au/wps/portal/nesa/teacher-accreditation/meeting-requirements/the-standards/proficient-teacher) 2.1.2, 2.3.2, 3.2.2, 7.2.2

This resource has been designed to support schools with successful implementation of new curriculum, specifically the NSW Department of Education approved elective course, iSTEM © 2021 NSW Department of Education for and on behalf of the Crown in right of the State of New South Wales.

The resource is produced to assist schools with promoting and implementing the course for the first time. As the course may be taught by teachers from a range of key learning areas, the resource is designed to support teachers from a variety of KLA expertise.

**Department approved elective course**: iSTEM

**Course outcomes**: ST5-1, ST5-2, ST5-3, ST5-4, ST5-5, ST5-6, ST5-7, ST5-8, S5T-9, ST5-10

**Author**: Curriculum Secondary Learners

**Publisher**: State of NSW, Department of Education

**Resource**: Teaching resource

**Related resources**: Further resources to support iSTEM can be found on the Department approved elective courses webpage including course document, sample scope and sequences, assessment materials and other learning sequences.

**Professional Learning**: Join the [Teaching and Learning 7-12 statewide staffroom](https://education.nsw.gov.au/teaching-and-learning/curriculum/statewide-staffrooms) for information regarding professional learning opportunities.

**Universal Design for Learning Tool**: [Universal Design for Learning planning tool](https://education.nsw.gov.au/teaching-and-learning/learning-from-home/teaching-at-home/teaching-and-learning-resources/universal-design-for-learning). Support the diverse learning needs of students using inclusive teaching and learning strategies.

**Consulted with**: Aboriginal Outcomes and Partnerships, Inclusion and Wellbeing, EAL/D.

**Reviewed by**: This resource was reviewed by Curriculum Secondary Learners and by subject matter experts in schools to ensure accuracy of content.

**Creation date**: 15th November 2022

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**Evidence base**:

‘The long-term vision is for a curriculum that supports teachers to nurture wonder, ignite passion and provide every young person with knowledge, skills and attributes that will help prepare them for a lifetime of learning, meaningful adult employment and effective future citizenship’ (NESA 2020:xi).

The development of the course and the course document as part of department approved electives aims to respond to the goals articulated in NESA’s curriculum review. Consistent messages from the review include:

* ‘flexibility’ was the word most used by teachers to describe the systemic change they want
* teachers need more time to teach important knowledge and skills
* students want authentic learning with real-world application.

This teaching resource provides teachers with some examples of explicit and authentic learning experiences. The option to adjust these learning sequences leads to ‘increased local decision making in relation to the curriculum’ as this ‘is associated with higher levels of student performance’ (NESA 2020:52).

The suggested strategies for teaching and learning align with the principles of explicit teaching. ‘The evidence shows that students who experience explicit teaching practices perform better than students who do not. … Explicit teaching reduces the cognitive burden of learning new and complex concepts and skills, and helps students develop deep understanding’ (CESE 2020a:11).

## References

**Links to third-party material and websites**

Please note that the provided (reading/viewing material/list/links/texts) are a suggestion only and implies no endorsement, by the New South Wales Department of Education, of any author, publisher, or book title. School principals and teachers are best placed to assess the suitability of resources that would complement the curriculum and reflect the needs and interests of their students.

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