Stage 5 – Graphics Technology – Here be dragons

It is intended that this unit runs almost concurrently with Core Module 1: Instrument drawing, with it having a couple of weeks lead time on the computer-aided design (CAD) content so that students develop their skills in a holistic manner and can apply the knowledge from one area to the other.

**Duration** - 20 weeks Detail: 60 hrs – 6 hrs a fortnight

## Outcomes

* **GT5 – 1** communicates ideas graphically using freehand sketching and accurate drafting techniques
* **GT5 – 3** designs and produces a range of graphical presentations
* **GT5 – 4** evaluates the effectiveness of different modes of graphical communications for a variety of purposes
* **GT5 – 5** identifies, interprets, selects and applies graphics conventions, standards and procedures in graphical communications
* **GT5 – 7** manipulates and produces images using digital drafting and presentation technologies
* **GT5 – 9** identifies, assesses and manages relevant WHS factors to minimise risks in the work environment

[Graphics Technology 7-10 Syllabus](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/learning-areas/technologies/industrial-technology-2019) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2019

## Unit overview

This unit introduces students to the concept of producing drawings using a range of computer software appropriate to the task. Students will complete a range of tasks in order to develop their skills and knowledge in using the software and ensuring they are working according to the correct drawing standards. [Onshape](https://www.onshape.com/en/) is used as the software for examples in the accompanying CAD exercises booklet, however other software could be used with minimal changes.

## Resources overview

### Physical resources

* 'Here be dragons' student resource (designed to be printed with a digital copy made available for accessing links)
* 'Here be dragons' CAD exercises booklet (designed to be distributed digitally)
* Computer room access with CAD software installed or internet access for cloud-based software
* 3D printers for extension task to print the 3D modelled parts
* Laser cutter to cut out larger components
* Hand tools and equipment to cut out components if the laser is not available
* Workshop space as necessary

### Websites

* Onshape - [onshape.com](https://www.onshape.com/)
* Autodesk Fusion 360 - [autodesk.com/campaigns/education/student-design](https://www.autodesk.com/campaigns/education/student-design)
* Autodesk – What is Computer Aided Manufacturing (CAM) - [autodesk.com/products/fusion-360/blog/computer-aided-manufacturing-beginners/](file:///C%3A%5CUsers%5Ccmacmurray2%5CAppData%5CLocal%5CMicrosoft%5CWindows%5CINetCache%5CContent.Outlook%5COVBEVMJC%5Cautodesk.com%5Cproducts%5Cfusion-360%5Cblog%5Ccomputer-aided-manufacturing-beginners%5C)
* Ultimaker Cura - [ultimaker.com/software/ultimaker-cura](https://ultimaker.com/software/ultimaker-cura)
* 3D printer commands list and tutorial - [all3dp.com/g-code-tutorial-3d-printer-gcode-commands](https://all3dp.com/g-code-tutorial-3d-printer-gcode-commands/)
* 3D Hubs - FDM 3D printing filaments compared - [3dhubs.com/knowledge-base/fdm-3d-printing-materials-compared](https://www.3dhubs.com/knowledge-base/fdm-3d-printing-materials-compared/)

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| Content | Teaching and learning | Evidence of learning | Adjustments and registration |
| **Week 1*** investigate and use computer-aided design (CAD) terminology
* compare and contrast the processes of producing drawings using manual techniques versus CAD techniques
 | **Teacher:*** introduces students to core module 2 of the graphics technology syllabus
* outlines the activities students will be undertaking and explains the reasoning behind the holistic approach to the 'Here be dragons' unit of work
* introduces students to the CAD software of choice such as Onshape, Fusion 360 or another CAD package. Directs students how to create an account and get logged on for the first time
* takes students through the main features of the program such as how to create a new sketch, the location of tools, the process for extruding sketches and other techniques necessary to get them started. This may be facilitated by utilising the online tutorials available for the CAD software of choice or through teacher delivery
* introduces students to the glossary of terms and explains that as they come across the terminology throughout this course of study, they will need to come back and fill in the definitions.

**Students:*** create a personal account for the chosen CAD software being used
* log in and follow teacher instructions
* begin to fill out the glossary for terms that they have identified.
 | * Students demonstrate a basic understanding of the process involved in getting access to the CAD software.
* Student completion of the glossary in work booklets shows an understanding of the language used within graphics.
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| * identify WHS issues related to ICT in the graphics industry and demonstrate safe and responsible work practices
 | **Teacher:*** recaps the WHS issues/risks related to products and processes within the graphics industry paying special attention to the ergonomics of the working environment
* gets the students to identify the sort of technology available to them in their own school setting as well as technology potentially available in other schools
* leads a brainstorming session with the students to identify the possible WHS issues related to digital technologies and information and communication technology within the graphics industry.

**Students:*** work collaboratively to complete a mind map of the possible WHS issues related to digital technologies and information and communication technology within the graphics industry.
 | * Students demonstrate their understanding of the WHS issues/risks associated with the graphics industry.
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| * explore the roles of professionals who use information and communication technology (ICT) in the graphics and related industries
 | **Teacher:** * elaborates on a range of professions within the graphics industry which have been discussed in the introduction to graphics course
* considers the ICT used by one of these professionals within the graphics industry, demonstrating the range of technology they may use on a day to day basis.

**Students:*** work in pairs to identify ICT used by each of the other identified professionals and record the information in their folios.

**Teacher:*** guides students to share what they have identified and record any extra information in their folios.
 | * Students are able to successfully work in collaboration with peers to identify the ICT used by professionals in graphics industries.
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| **Week 2*** investigate and use computer-aided design (CAD) terminology
* explore the relationship of CAD applications to computer-aided manufacture (CAM)
* compare and contrast the processes of producing drawings using manual techniques versus CAD techniques
 | **Teacher:*** identifies the benefits of producing drawings using CAD over traditional manual drafting techniques
* explains how drawings generated in a CAD program can be used to generate physical parts and components using Computer Aided Manufacturing (CAM) techniques
* explores the different types of CAM and considers the use of CAM equipment within the school environment including:
	+ CNC router
	+ water, plasma, and laser cutters
	+ milling machines
	+ lathes
	+ 3D printers.

**Students:*** use the information provided to define what computer aided manufacturing means to them, they can use the [Autodesk - What is Computer Aided Manufacturing (CAM)?](https://www.autodesk.com/products/fusion-360/blog/computer-aided-manufacturing-beginners/) blog to help
* research and articulate the use and scope of work for each of the identified CAM technologies in the folio.
 | * Students are able to articulate their understanding of what CAM means to them.
* Students are able to demonstrate their understanding by identifying the potential use of the different CAM technologies and recording them in their work booklet.
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| * explore the relationship of CAD applications to computer-aided manufacture (CAM)
* investigate and use various file formats and images associated with CAD, CAM and related ICT
 | **Teacher:*** explains the different CAD file formats used in relation to the software packages available to the students and relates them to the types of tasks being addressed
* discusses the use of slicing software such as [Ultimaker’s Cura](file:///C%3A%5CUsers%5Ccmacmurray2%5CAppData%5CLocal%5CMicrosoft%5CWindows%5CINetCache%5CContent.Outlook%5COVBEVMJC%5Cultimaker.com%5Csoftware%5Cultimaker-cura) and demonstrates its use to control the output of CAD files to CAM technologies
* explains that G-code is a simple language used to communicate with CAM technologies and shows examples using [3D printer commands list and tutorial](https://all3dp.com/g-code-tutorial-3d-printer-gcode-commands/) of what it looks like and how it works
* expands on the topic of 3D printers previously discussed as part of CAM technologies, including using the [3D Hubs website](https://www.3dhubs.com/knowledge-base/fdm-3d-printing-materials-compared/) to look at the types of commonly used filaments for fused filament fabrication (FFF)
* briefly explains the other methods 3D printing listed in the student booklet.

**Students:*** use the [3D Hubs website](https://www.3dhubs.com/knowledge-base/fdm-3d-printing-materials-compared/) to identify the features and properties of the different filaments identified in the student booklet.
 | * Students display their investigative abilities by being able to find and record the features and properties of the filaments.
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| **Week 3*** apply Australian technical drawing standards in the production of drawings
* explore the concepts of 2D and 3D coordinate geometry, and their application in CAD modelling
 | **Teacher:*** explains the requirements for meeting the AS1100 drawing standards and how they apply to setting up drawings within the CAD package of choice
* demonstrates using a simple 3D block shape how to generate the drawings within the CAD package
* demonstrates how the combination of 2D and 3D geometry is used to generate objects in the CAD package, including using the different planes to orientate the view and control the space.

**Students:*** experiment within the CAD package of choice and familiarise themselves with drawing on the different planes and generating drawings from the simple 3D objects in order to meet AS1100 standards.
 | * Students exhibit skills in generating CAD drawings that are developing as they complete the tasks.
* Students completed CAD drawings demonstrate an understanding of the requirements of AS1100.
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| * manage graphics projects individually and collaboratively
* investigate and use computer-aided design (CAD) terminology
* use CAD modelling and rendering to visualise and experiment with designs
* use appropriate CAD software to produce graphical images for a given situation
 | **Teacher:*** introduces the first of the CAD exercises, taking students through the steps of construction as per the CAD exercises booklet.
* demonstrates the process and highlights the terminology used and the different tools and their location within the software.

**Students:*** follow the teacher demonstration, completing the glossary of terms in the student work booklet
* complete each of the exercises as directed.
 | * Students are able to follow the examples and demonstrate their understanding by completing the exercises laid out in the CAD exercises booklet.
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| **Weeks 4 – 12*** manage graphics projects individually and collaboratively
* identify WHS issues related to ICT in the graphics industry and demonstrate safe and responsible work practices
* use CAD modelling and rendering to visualise and experiment with designs
* use appropriate CAD software to produce graphical images for a given situation
* generate freehand sketches to illustrate or communicate information to be used in CAD applications
 | **Teacher:*** continues to demonstrate the construction of each of the parts in the CAD exercises booklet
* highlights the designable elements of the project whilst reinforcing the importance for the layout of the connections to remain the same so that the automaton will still function
* suggests some possible places students might search for information on dragons.

**Students:** * follow the teacher demonstration, completing the glossary of terms in the student work booklet
* complete each of the exercises as directed
* complete the design exercises in the student booklet for the dragon body parts by carrying out research to inform their designs.
 | * Students demonstrate ongoing development of skills and knowledge through the completion of each of the exercises in the CAD exercises booklet.
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| **Week 13 & 15*** manage graphics projects individually and collaboratively
* apply standard features of CAD software
* use CAD modelling and rendering to visualise and experiment with designs
 | **Teacher:*** identifies and discusses the different mates used to create assemblies and explains how they function in relation to the project
* demonstrates the use of assemblies to combine parts using the CAD exercises booklet to work through the process of building the automaton
* shows students the completed automaton dragon assemblies to model what their assemblies should look like.

**Students:*** follow teacher demonstration, making notes and completing the glossary of terms in the student work booklet
* assemble the automaton following the instructions provided.
 | * Students are able to successfully follow the instructions to assemble their automaton.
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| **Week 16 & 17*** use CAD modelling and rendering to visualise and experiment with designs
* collect information from a range of sources to assist in the development of project work
 | **Teacher:*** demonstrates how to modify existing sketches to update parts or how to generate new parts that still meet the requirements for setting out
* demonstrates replacing parts into existing assemblies or replacing sub-assemblies into final assemblies.

**Students:*** generate new parts based on their research and sketches and swap them for the original components in the assembled automaton.
 | * Students demonstrate their design skills through the modification of the parts and the substitution in their assemblies.
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| **Week 18 & 19*** generate CAD orthogonal drawings, selecting appropriate views and drawing types for a particular context
* produce pictorial drawings using CAD applications
* create presentation drawings using CAD or appropriate graphics software
 | **Teacher:*** demonstrates the process for animating the automaton as outlined in the CAD exercises booklet
* troubleshoots and discusses any problems students are having with generating the animation
* demonstrates how to use the windows game centre on windows PCs to capture the animation using Win+Alt+G and how to share their files through the CAD package
* explains how AS1100 defines the layout of drawings and reinforces the relationship with ANSI and ISO standards
* demonstrates the process using the CAD exercises booklet as necessary for the generation and annotation/dimensioning of working and pictorial drawings of the automaton
* demonstrates how to screen capture a pictorial view of the automaton and insert it into a drawing with a title block.

**Students:*** generate and record their animations according to the instructions provided and share them with their teacher through the CAD package
* generates working and pictorial drawings of their automatons, adding dimensions and annotations as necessary, saving them within their chosen CAD package.
 | * Students are able to successfully follow the instructions to animate and produce drawings of their automaton.
* Students drawings demonstrate an understanding of the AS1100 requirements.
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| **Week 20*** use appropriate CAD software to produce graphical images for a given situation
* generate CAD orthogonal drawings, selecting appropriate views and drawing types for a particular context
* produce pictorial drawings using CAD applications
* create presentation drawings using CAD or appropriate graphics software
 | **Teacher:*** demonstrates how to export drawings to pdf format and save the files locally ready for printing
* shares a USB drive around the class for students to save their drawings to for the teacher to organise printing (either of all drawings or selected drawings at a larger size for putting up around the room)
* explains the importance of evaluation as part of the design process and gets students to complete the evaluation in their work booklet
* gets students to present the rendered pictorial view of their completed customised automaton to the class and describe the modifications they have made, and the problems encountered that they have overcome.

**Students:*** export their drawings and save them/submit them to the teacher on the provided USB drive
* complete the evaluation section in their work booklets
* present their finished automatons to the class, including the problems and solutions they dealt with.
 | * Students present their drawings to the class, which allows them to demonstrate and explain the choices they made and the effect they had on the finished automaton.
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| **Extension activities** | * Students who complete their work ahead of time could be allowed to 3D print, laser cut and/or manually produce the different components to make a physical dragon automaton, under teacher guidance.
* When customising their dragon, students could add legs or other features to make them look more realistic.
* Students could generate a different animal instead, using the similar body components/shapes, such as a pegasus, eagle, griffin, phoenix, or seagull.
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## Evaluation

Evaluation of learning activities should be an ongoing process that happens throughout the delivery of this unit. Teachers should document their evaluation of learning activities throughout the program. The space provided below is to evaluate the overall unit of work.

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