# iSTEM – Surveying and geospatial engineering



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## Surveying and geospatial engineering

The role of the surveyor is to map the man-made and natural environment, and provide authoritative advice on future infrastructure development, new living spaces, or protection of natural spaces. Surveyors work collaboratively with the community, town planners, developers, engineers, architects, and other professionals.

Surveyors and geospatial professionals use state of the art equipment and developing technologies such as Global Positioning Systems (GPS), satellite imagery, laser scanning, and powerful computing programs to collect positional data to create complex layers of interconnected geospatial information. Surveyors and geospatial professionals measure to millimetre accuracy. Geospatial information constantly reveals new insights about our world and our place in it.

In this specialised topic, students develop skills and knowledge used in the surveying and geospatial professions by completing inquiry-based and problem-based learning tasks.

### Duration of learning

Indicative time – 25 hours.

### Inquiry question

Why do we need to accurately model the real world?

### 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, 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 [Global NSW Strategy](https://www.global.nsw.gov.au/).

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 [Global NSW Strategy](https://www.global.nsw.gov.au/) and 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. Core modules must precede options in the delivery of the course, consult the course document for further details on timing of core and options.

## 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 to record adjustments and enhancements that are made to the learning sequence during its implementation. For further advice see [Inclusive practice resources for secondary school](https://education.nsw.gov.au/campaigns/inclusive-practice-hub/secondary-school).

Aboriginal perspectives which relate to the individual school community should be included in learning sequences. Consultation with local Aboriginal groups including local NSW Aboriginal Education Consultative Group (AECG) is recommended. For further advice see [Aboriginal education in NSW public schools](https://education.nsw.gov.au/teaching-and-learning/aec/aboriginal-education-in-nsw-public-schools).

EAL/D learners enrolled in iSTEM who are at the consolidating phase of acquiring English language skills will benefit from explicit teaching of subject-specific terminology and may require a little more time to absorb the information. Consider language and cultural demands of content and tasks and beware of barriers to learning due to assumed knowledge. Scaffolded activities which build the field to introduce new concepts and language, message abundancy, modelling and deconstruction of key language features and structures will assist EAL/D learners. For further advice see [English as an additional language or dialect](https://education.nsw.gov.au/teaching-and-learning/curriculum/multicultural-education/english-as-an-additional-language-or-dialect).

HPGE learners may benefit from extension and additional challenge in iSTEM. It is important to assess and identify these learners to target areas of growth and improvement. For further advice see [Teaching and learning HPGE](https://education.nsw.gov.au/teaching-and-learning/high-potential-and-gifted-education).

### Weeks 1 and 2

Table – Surveying and geospatial engineering weeks 1 and 2 learning sequence

|  |  |  |  |
| --- | --- | --- | --- |
| Outcomes and content | Teaching and learning | Evidence of learning | Adjustments and registration |
| **Week 1 – Introduction****ST5-5, ST5-10**Students:* outline historical perspectives in surveying and geospatial engineering that have impacted society
* investigate geometrical and trigonometrical techniques used by surveyors and geospatial professionals
* describe the contribution that surveying and geospatial professionals make toward the world in which we live
* engage in industry career development opportunities to gain a deeper knowledge of the surveying and geospatial engineering professions, develop skills, knowledge and understanding of authentic, real-world problem-solving opportunities
 | **Teacher**Introduce surveying and geospatial engineering topic.**Teacher and students**Explore the conceptual difficulties regarding point of reference.Outline difficulties in answering the question ‘Where am I now?’Prompt students with questions, for example:* What is your physical location?
* How can you describe your position?
* Does that position change if parameters or labels change?
* If you were communicating with someone in another country, how would you give a precise description of your location?

**Teacher**Present [What are songlines? (1:52)](https://youtu.be/kVOG-RKTFIo). Outline the use of landmarks in songlines as referred to in [Songlines: the Indigenous memory code](https://www.abc.net.au/radionational/programs/allinthemind/songlines-indigenous-memory-code/7581788).Identify local songlines with consultation from the local AECG and/or local Aboriginal community. Use aerial imaging to see if there is a correlation between songlines and present-day roads.**Teacher and students**Reflect on the significance of landmarks within Aboriginal culture.**Teacher**Present [A snapshot of surveying in NSW – A life without limits (2:47)](https://www.alifewithoutlimits.com.au/study/pathways-nsw/).Describe the roles of a surveyor, for example:* apply the laws and procedures relating to land ownership, boundaries, and titles
* accurately determine positions of boundaries
* study the natural and urban environment
* plan and provide critical advice for land development projects
* select technologies to measure angles, distances, and elevations on the land from a point of reference
* manage uncertainty when making measurements.
 | Students can identify the crucial role surveyors have in providing certainty and precision regarding land ownership and development.Students can identify surveyors as essential to maintaining the integrity of land administration systems.Students engage with the concept of reference points and the difficulties in identifying their exact position in the universe.Students can describe songlines and their purpose. | Use closed captions when viewing video to assist understanding and vocabulary building. Pause video to assess student understanding at appropriate points.Provide worksheet with key terms to assist with vocabulary building and knowledge acquisition. |
| **Producing plans****ST5-2, ST5-4, ST5-5**Students:* use a variety of tools and techniques to record observation and measurements with appropriate accuracy, for example, notes, sketches, photography, tape measures, trundle wheels, measuring and capture technologies.
 | **Teacher Preparation****Modify** [mapping the classroom activity](https://serc.carleton.edu/NAGTWorkshops/gis/activities2/47972.html) **for the school context. During modification of activity, rename ‘maps’ to ‘plans’.****Teacher****Introduce the activity and explain the task of creating a plan of the classroom.****Students**Create Plan 1.**Teacher and students**Compare different versions of Plan 1 that are created, including measurements, scales, and points of reference used.**Teacher**Provide Base plan for Plan 2 activity which provides students with a reference point. Direct students to use available measurement devices, for example:* tape measures
* compasses
* angle finders
* levels
* smartphone applications.

**Students**Create Plan 2 using Base plan and resources provided. | Students participate in mapping activity and identify the importance of reference points and measurements when creating maps. | Adjust activity based on school context, resources, and individual student needs. The classroom could be replaced with other learning spaces both indoors and outdoors in the school. Remember that Map 1 and Map 2 are of the same room or space. |
| **Precision and accuracy****ST5-2, ST5-4, ST5-5**Students:* discuss methodologies surveyors use to provide confidence in their measurements and inform their decisions or professional judgements
* compare concepts of precision and accuracy in the production of plans and maps
* explain how surveyors manage the uncertainty in measurements and determine what is acceptable within prescribed tolerances
* evaluate data used in surveying and geospatial engineering
 | **Teacher and students**Complete mapping activity from last lesson.Compare and evaluate plans created.Explore the concepts of precision and accuracy in measurements and the production of plans.Describe the importance of points of reference when taking measurements and creating plans. Identify the need for accurate positions, angles, and distances to establish plans and boundaries.Identify surveying as the profession that accurately determines positions and the distances and angles between them.**Teacher Note**Classroom arrangements may have changed between lessons. This will add to the ‘uncertainty’ discussion further in this lesson.**Teacher****Identify the types of maps used by surveyors.****Identify the types of plans created by surveyors.****Explain the difference between maps and plans.**Explain methodologies surveyors use to provide confident measurements and judgements.Explain how surveyors manage the uncertainty in measurements and determine what is acceptable within prescribed tolerances.Identify equipment used by surveyors to provide greater levels of precision and accuracy, for example:* cameras
* Electronic distance measurement (EDM)
* Global Positioning System (GPS)
* laser scanners
* Light Detection and Ranging (LiDAR)
* Total station (TS)
* drones for aerial imaging.

**Teacher and students**Explore the use of star maps for navigation in [Australian Indigenous Astronomy](http://www.aboriginalastronomy.com.au/content/topics/starmaps/). | Students participate in mapping activity and identify the importance of reference points and measurements when creating maps.Students demonstrate capacity to use different measuring devices.Students identify uncertainty is managed by surveyors and different technologies are used by surveyors to manage this uncertainty and provide increased levels of precision and accuracy.Students can describe star maps and their navigation function. | Adjust activity based on school context, resources, and individual student needs. The classroom could be replaced with other learning spaces both indoors and outdoors in the school. Remember that Plan 1 and Plan 2 are created for the same room or space.Provide a concise worksheet identifying surveying equipment and summarising their use. |
| **Weekly reflection** | **Students**Complete weekly reflection using the following steps:identify tasks undertaken, new knowledge, understanding or skillsevaluate new knowledge, understanding or skills in light of previous knowledgeanalyse key insights and pose questions regarding their future learning. | Students answer reflective questions, for example:What did I learn about surveying this week?How challenging was map making? Why?Did I learn best when receiving information, applying knowledge, or communicating? | Modelling of the reflective process may assist with the metacognitive (thinking about thinking) aspects of this task.Procedural recount to be prepared on paper or digitally, including speech to text or voice recording. |
| **Week 2 – Thinking mathematically****ST5-4, ST5-5, ST5-9**Students:* investigate geometrical and trigonometrical techniques used by surveyors and geospatial professionals
* apply fundamental mathematical techniques related to the surveying and geospatial professions
 | **Teacher**Identify the use of trigonometry in surveying from [A Building Surveyor uses Trigonometry](https://xerte.uwe.ac.uk/play.php?template_id=3448#page1).Present [Heights and Distances 10th Maths (4:11)](https://www.youtube.com/watch?v=7VqP04EVfsw).**Teacher and students**Use worked solutions to practice using trigonometry.**Teacher**Choose structures that students can use to calculate height.Demonstrate measuring equipment for students to use, for example:* measuring tapes
* [clinometer](https://brainchase.com/build-clinometer/)
* angle ruler or angle measurer
* level
* compass.

**Students**Measure angles and distances required to calculate the height of a designated structure.**Teacher and students**Discuss calculations.Transition to next lesson by identifying other uses for this trigonometric calculation. | Students participate in trigonometry activity.Students can accurately use measuring devices to determine angle of elevation and distance from building.Students demonstrate ability to use trigonometry in calculation of building height. | Review key concepts and vocabulary before viewing video. Use closed captions and provide the transcript. Pause video to assess student understanding at appropriate points.Provide a worksheet with scaffolded examples of trigonometric calculation.Provide a worksheet with gradually decreasing scaffold for trigonometry calculation. |
| **Thinking mathematically****ST5-4, ST5-5, ST5-9**Students:* investigate geometrical and trigonometrical techniques used by surveyors and geospatial professionals
* apply fundamental mathematical techniques related to the surveying and geospatial professions
 | **Teacher**Explain how to use trigonometry as a method for determining distance to an object.**Teacher and students**Use worked solutions to practice using trigonometry to find the distance to a far object.**Teacher**Provide measuring equipment for students to use, for example:* measuring tapes
* compass
* protractors
* angle ruler or angle measurer.

**Teacher and students**Determine the distance to a far object.Point A is your starting point.Sight an object (point D) from point A.Starting from A, walk 20 metres in a direction that is perpendicular to line AD. This is point B. Note, angle DAB is a right angle.Sight the far object at location D from location B and measure angle ABD.Use trigonometry to determine the distance from location A to the far object at location D (side AD).Engage in activity and trouble shoot problems that may occur, for example:* determining an exact 90-degree angle at DAB
* measuring angle ABD
* sighting positions accurately
* sighting positions with interference.

**Teacher**Provide support and check calculations during activity.Relate the activity to surveying in the field.**Teacher and students**Explore the idea of using this calculation for finding the distance to an object on the other side of a deep canyon.Note: See [Measuring distances – triangulation](http://web.mnstate.edu/colson/est/meastriangm.html) for further information. | Students participate in trigonometry activity.Students can accurately use measuring devices to determine angle and distance.Students demonstrate ability to use trigonometry in calculating the distance to an object.Students identify the importance of accuracy when measuring angles and distances that will be used for calculations. | Review key concepts and vocabulary from last lesson before activities in this lesson.Provide worksheet with scaffolded examples of trigonometric calculation.Provide worksheet with gradually decreasing scaffold for trigonometry calculation. |
| **GPS****ST5-2, ST5-4, ST5-5**Students:* explore georeferencing techniques in the production of solutions to surveying and geospatial problems
* interpret and visualise geospatial data
* describe measuring and capture technologies used in surveying and geospatial engineering
 | **Teacher preparation**Prepare a worksheet that contains an aerial image of the school obtained from [Spatial Information Exchange (SIX) maps](https://maps.six.nsw.gov.au/).**Teacher**Revise bearings and explain the [coordinate system](https://www.icsm.gov.au/education/fundamentals-mapping/earths-coordinate-system), latitude, and longitude. Present [UTM – A Quick Tutorial (3:51)](https://www.youtube.com/watch?v=4LmxEFeZrqg) to briefly identify eastings and northings as a different coordinate system to latitude and longitude.Define Global Positioning System (GPS) as a type of global navigation satellite system (GNSS).Present [How Do GPS Coordinates Work? (4:14)](https://www.youtube.com/watch?v=ALN7gXF1thY).Introduce mapping activity on latitude and longitude.Provide coordinates for students to find and plot on the worksheet.**Students**Using a GPS device or phone compass app with latitude and longitude, walk around to find and plot coordinates on the worksheet map.**Teacher and students**After the activity, compare coordinates made on the maps by different students.Discuss differences in coordinate plots and discuss location uncertainty.Discuss accuracy of different GNSS/GPS devices and how they can provide more certainty to surveyors. | Students demonstrate understanding of coordinates and GPS in determining and communicating location.Students demonstrate understanding of the uncertainty surrounding GPS coordinates and understand there are different systems that are used. | Review key concepts and vocabulary before viewing video. Use closed captions when viewing video to assist understanding and vocabulary building. Pause video to assess student understanding at appropriate points.Model coordinate finding and plotting with students and apply appropriate levels of supervision for the context. |
| **Weekly reflection** | **Students**Complete weekly reflection using the following steps:* identify tasks undertaken, new knowledge, understanding or skills
* evaluate new knowledge, understanding or skills in light of previous knowledge
* analyse key insights and pose questions regarding their future learning.
 | Students answer reflective questions, for example:* What did I learn about surveying this week?
* Did I learn best when receiving information, applying knowledge, or communicating?
 | Modelling of the reflective process may assist with the metacognitive (thinking about thinking) aspects of this task.Procedural recount to be prepared on paper or digitally, including speech to text or voice recording. |

### Weeks 3 and 4

**Note:** Google Earth and smartphone applications use coordinate setting WGS84 which is similar to the ‘Geographic DMS’ coordinate setting when using the ‘coordinate tool’ in ‘SIX Maps’.

Table – Surveying and geospatial engineering weeks 3 and 4 learning sequence

|  |  |  |  |
| --- | --- | --- | --- |
| Outcomes and content | Teaching and learning | Evidence of learning | Adjustments and registration |
| **Week 3 – Images from above****ST5-5**Students:* outline historical perspectives in surveying and geospatial engineering that have impacted society
* explore georeferencing techniques in the production of solutions to surveying and geospatial problems
* interpret and visualise geospatial data
 | **Teacher**Review class understanding of rotation and orbits.Use [Types of orbits](https://www.esa.int/Enabling_Support/Space_Transportation/Types_of_orbits) or [Catalog of Earth Satellite Orbits](https://earthobservatory.nasa.gov/features/OrbitsCatalog) to briefly describe these 3 orbits and significant activities that occur due to differences in coverage:* low earth orbit (LEO): better resolution, better for images
* medium earth orbit (MEO): better coverage, better for positioning (GPS)
* geosynchronous earth orbit (GEO): constant relative position, better for global communications.

Present the first 5 minutes of [GPS, how does it work? (7:18)](https://www.youtube.com/watch?v=8eTlI19_57g).Describe the use of GNSS satellites for GNSS/GPS coordinates and positioning.**Teacher and Students**Use free smartphone applications to view GNSS satellite positions in the sky with augmented reality. Count the number of GNSS satellites in the sky at the time of viewing.**Teacher**Outline processes of collecting aerial imagery and compare with satellite imagery, for example:* image altitude
* resolution.

Identify the [sources of imagery](https://support.google.com/earth/answer/6327779?hl=en#zippy=%2Csatellite-aerial-images%2Chistorical-images) from Google’s website on imaging platforms. | Students demonstrate understanding that there are different orbit types for different satellite activities.Students can identify sources of GPS data and aerial imagery.Students demonstrate capacity to navigate GIS systems. | Joint reading of significant parts of chosen text to create outline of key terms.Review key concepts and vocabulary before viewing video. Use closed captions when viewing video to assist understanding and vocabulary building. Pause video to assess student understanding at appropriate points.Model the use of GNSS view and the GIS ‘SIX Maps’.Check the accessibility of apps to ensure they can be accessed by students with disability. |
| **Images from above****ST5-5**Students interpret and visualise geospatial data | **Teacher and students**Compare the [SIX Maps](https://maps.six.nsw.gov.au/) 1943 aerial photography imagery with current imagery of famous Sydney landmarks, for example:* Opera House
* Cockatoo Island
* Sydney Airport
* North Head barracks.

Set the **Basemaps** foreground to **NSW Imagery** and background to **Sydney 1943 Imagery**. Use slider to switch between images. | Students can interpret features and details from aerial images, for example:* the Opera House was not there in 1943
* warships around Cockatoo Island
* details and differences at Sydney Airport.
 | Model the use of the GIS ‘SIX Maps’. Create a step-by-step guide to ‘SIX maps’. Set up and use to find coordinates. |
| **Coordinates****ST5-2, ST5-4, ST5-5**Students investigate analysing and visualisation technologies, for example:* geographic information systems (GIS)
* Google Earth
 | **Teacher and students**Review understanding of latitude and longitude.Use [Google Earth](https://earth.google.com) to determine the coordinates of a variety of specific points in the school.Use [SIX Maps](https://maps.six.nsw.gov.au/) coordinate tool to determine the coordinates of the same points in the school. Set the coordinate setting to **Geographic DMS** when using the **Coordinate Tool** in ‘SIX maps’.Evaluate any differences in latitude and longitude with Google Earth and ‘SIX Maps’.Discuss the importance of using precise coordinates in planning and surveys. | Students recall use of coordinates, latitude and longitude in determining and communicating location.Students demonstrate capacity to navigate GIS systems to gather data.Students can communicate the importance of using precise coordinates in planning and surveys. | Model the use of Google Earth and the GIS ‘SIX Maps’. Create a step-by-step guide to ‘SIX maps’ setup and use to find coordinates. Joint read this guide to help ensure understanding. |
| **Hidden monuments****ST5-2, ST5-4, ST5-5**Students use a variety of tools and techniques to record observation and measurements with appropriate accuracy | **Teacher Preparation**Plan hidden monuments activity. Carefully bury a coin or marker. Measure precise distance and bearing of each step to create a ‘treasure map’.**Teacher**Demonstrate the use of a compass to find true bearings.Introduce ‘treasure map’ activity.Provide ‘treasure map’ and equipment, for example:* measuring tapes
* trundle wheel
* compass.

**Students**Read map, and move required distance along given bearings.Follow steps to the ‘treasure’.Plant a flag where they believe the ‘treasure’ is.**Teacher and students**Assess accuracy of measurements.Identify challenges and difficulties.**Teacher**Explain the use of bearings in surveying and geospatial engineering to communicate direction.Explain the link between the treasure map and surveyors’ plans.Define the terms:* cadastre
* monumented cadastre
* cadastral surveying
* permanent survey mark.
 | Students can accurately use measuring devices to determine bearings and distance.Students identify the importance of accuracy when measuring and communicating bearings and distances. | Use magnetic north without declination adjustment to enhance accessibility of activity.Adjust activity based on school context, grounds, safety, resources, and individual student needs. |
| **Weekly reflection** | **Students**Complete weekly reflection using the following steps:* identify tasks undertaken, new knowledge, understanding or skills
* evaluate new knowledge, understanding or skills in light of previous knowledge
* analyse key insights and pose questions regarding their future learning.
 | Students answer reflective questions, for example:* What did I learn about surveying this week?
* Did I learn best when receiving information, applying knowledge, or communicating?
* What did I enjoy doing this week?
 | Modelling of the reflective process may assist with the metacognitive (thinking about thinking) aspects of this task.Procedural recount to be prepared on paper or digitally, including speech to text or voice recording. |
| **Week 4 – Point of reference****ST5-5, ST5-10**Students:* develop an understanding for the need to build in redundancies when designing solutions to surveying and geospatial problems
* outline historical perspectives in surveying and geospatial engineering that have impacted society
* investigate legal, ethical, and moral responsibilities of surveyors and geospatial professionals
* explore georeferencing techniques in the production of solutions to surveying and geospatial problems
* interpret and visualise geospatial data
* explain how surveyors manage the uncertainty in measurements and determine what is acceptable within prescribed tolerances
 | **Teacher**Explain how surveyors manage uncertainty and determine what is acceptable within prescribed tolerances.Present sections from [The mysterious art of cadastral land surveying](https://www.spatialsource.com.au/the-mysterious-art-of-cadastral-land-surveying/). Identify difficulties that surveyors come across when attempting to define boundaries.Explain the use of survey marks, cadastral monuments, and hierarchy of evidence in defining boundaries.Introduce [Protecting survey marks [PDF 751.03KB]](https://www.spatial.nsw.gov.au/__data/assets/pdf_file/0004/229945/Protecting_survey_marks_-_Information_Sheet.pdf) document.**Students**Assess the importance of survey marks and justify the expense in preserving this survey infrastructure.**Teacher**Explain how permanent survey marks are fundamental to the integrity of land administration systems and spatial infrastructure. This includes geographic information systems (GIS) and databases that are the primary spatial management tools for all levels of government.Note: See [Preservation of Survey Infrastructure’ [PDF 293.7 KB]](https://www.spatial.nsw.gov.au/__data/assets/pdf_file/0005/217094/Direction_No._11.pdf) (POSI) for more information. | Students can gather information from sources regarding challenges surveyors face and the importance of reference points.Students can identify the use of survey marks, cadastral monuments, and hierarchy of evidence in defining boundaries. | Model strategies that assist understanding if reading complicated texts (professional articles), for example:* explicit breakdown of titles, headings, and keywords
* highlight key sentences pertaining to the uncertainty surveyors face
* highlight key sentences highlighting the important role surveyors have.
 |
| **Survey marks****ST5-2, ST5-4, ST5-5**Students:* investigate legal, ethical, and moral responsibilities of surveyors and geospatial professionals
* evaluate data used in surveying and geospatial engineering
* explore georeferencing techniques in the production of solutions to surveying and geospatial problems
 | **Teacher preparation**Before class, make a ‘school survey mark’ within the school. Record bearing and distances to ‘school survey mark’ from school landmarks.**Teacher and students**Use [SIX Maps](https://maps.six.nsw.gov.au/) to find survey marks around the area/school. (Open **Map Contents** and select the **Survey Marks** tab.)Identify that many survey marks are near busy roads and dangerous places, and this is a hazard surveyors manageIntroduce the concept of a ‘school survey mark’ that was prepared earlier. Indicate the general location of the survey mark.**Teacher**Identify the legal, ethical, and moral responsibilities of surveyors and geospatial professionals.Identify that only surveyors can replace survey marks.**Teacher and students**Determine the precise coordinates of the ‘school survey mark’ (using bearings and distances from fixed school landmarks to the school survey mark).Review bearings and measurement.Provide students with measuring equipment, for example:* compasses
* measuring tape
* survey flags/chalk.

Use the **Coordinate Tool** and **Distance Tool** in ‘SIX Maps’ to determine the coordinates of the ‘school survey mark’.Identify accurate measurements and clear points of reference to determine position.**Teacher**Highlight the importance of valid, authentic, and accurate data in surveying and geospatial engineering.**Teacher Note**Survey marks are usually near roads. Students finding these marks may be dangerous. Spraying the bottom of a can red and burying it bottom up can work as a school survey mark. Place the survey mark in a safe location, possibly near the plots that will be used in weeks 7 and 8. Select a location that has access to landmarks that can be used in the coordinate activity. | Students can accurately use measuring devices to determine bearings and distance.Students identify the importance of accuracy when measuring and communicating bearings and distances.Students demonstrate ability to navigate GIS systems to gather data.Students can interpret structures and details from aerial images for the purpose of measuring from landmarks, for example:* buildings
* goal posts
* pit lids
* court markings
* seats.
 | Use magnetic north without declination adjustment to enhance accessibility of activity if using bearings.Adjust activity based on school context, grounds, safety, resources, and individual student needs.Model the use of measuring equipment and GIS software. |
| **Geographic Information Systems (GIS)****ST5-2**Students:* interpret and visualise geospatial data
* use project management techniques to plan solutions to surveying and geospatial projects
* utilise communication techniques in the development of surveying and/or geospatial reports and plans
 | **Teacher**Explain [GIS](https://education.nationalgeographic.org/resource/geographic-information-system-gis) as a method of capturing, storing, and displaying data related to positions on Earth’s surface. Briefly refer to ‘SIX Maps’, that was previously used, and specify the features that make it a GIS that overlays multiple sets of data, for example:* aerial imagery
* street views
* coordinates
* locations and addresses
* survey marks
* property boundaries.

Introduce the [Spatial Map Viewer](https://portal.spatial.nsw.gov.au/portal/apps/webappviewer/index.html?id=44e72c6c7ccf498cb1c822b740c647d3).Demonstrate setting the base map to **NSW Imagery Basemap** from the **Basemap Gallery**.Demonstrate **Layer List Widget** and selection of the following:* NSW elevation and depth theme – contour
* Survey mark GDA2020.

**Teacher and students**Use Spatial map viewer to explore the local area (or area of interest).Identify contour lines and discuss what they represent.Evaluate contour lines and the relationship to waterways, dams, hilltops, slopes, roadways, and built-up areas.Select different contour lines to determine direction of a slope. When selecting a contour line, the data presented shows elevation which indicates the height above mean sea level.Discuss the importance of knowing contour in different contexts, for example, when building a:* dam
* house
* road
* drainage system.
 | Students demonstrate capacity to navigate a GIS to gather data.Students can identify types of information that can be obtained from a GIS.Students demonstrate understanding of contour lines and elevation data.Students use two-dimensional contour data to understand three-dimensional implications, for example:* a bad location to build a house may be a good location to build a dam
* roads may not follow a straight line due to elevations, as well as historic boundaries.

Students demonstrate understanding that when selecting a contour line, the data presented shows elevation which indicates the height above mean sea level. | N/A |
| **Weekly reflection** | **Students**Complete weekly reflection using the following steps:* identify tasks undertaken, new knowledge, understanding or skills
* evaluate new knowledge, understanding or skills in light of previous knowledge
* analyse key insights and pose questions regarding their future learning.
 | Students answer reflective questions, for example:* What did I learn about surveying this week?
* Did I learn best when receiving information, applying knowledge, or communicating?
* What did I enjoy doing this week?
 | Modelling of the reflective process may assist with the metacognitive (thinking about thinking) aspects of this task.Procedural recount to be prepared on paper or digitally, including speech to text or voice recording. |

### Weeks 5 and 6

Table – Surveying and geospatial engineering week 5 learning sequence

|  |  |  |  |
| --- | --- | --- | --- |
| Outcomes and content | Teaching and learning | Evidence of learning | Adjustments and registration |
| **Weeks 5 – Survey plans****ST5-5, ST5-10**Students:* interpret and visualise geospatial data
* use project management techniques to plan solutions to surveying and geospatial projects
* utilise communication techniques in the development of surveying and/or geospatial reports and plans
* investigate the nature of the work and pathways into surveying and geospatial engineering professions
* outline how surveyors interact with and support allied professionals
* describe the contribution that surveying and geospatial professionals make toward the world in which we live
* develop an understanding of surveying and the geospatial engineering professions
 | **Teacher**Introduce boundary survey plans, topographic survey plans, and shadow diagrams to students. Use council website search functions to find and use public access council development applications (DA) or applications on exhibition, for example:* [Survey examples](http://www.georgialandsurveying.com/survey-examples/)
* [NSW planning portal](https://www.planning.nsw.gov.au/About-Us/NSW-Planning-Portal)
* [City of Sydney](https://www.cityofsydney.nsw.gov.au/development-applications/search-development-applications)
* [Lake Macquarie City](https://property.lakemac.com.au/ePathway/Production/Web/GeneralEnquiry/EnquiryLists.aspx).

**Teacher and students**Explore survey plans and discuss features, for example:* title
* heading
* scale
* underground services
* existing structures
* benchmarks
* ground levels
* coordinates
* compass rose
* area.

**Teacher**Ask questions about interpreting plans to test student understanding.Use this lesson to transition into surveying levels and topography of sites. | Students can identify a plan and some features of a plan.With assistance, students can use the scale on a plan to convert plan measurements into actual measurements.Students can read the contours on a topographic survey plan to determine slope and elevation.Students can interpret plans to answer discussion questions, for example:* What do these levels tell us about the direction water will flow?
* How will these levels affect development?
* How will these plans and measurements be used by allied professionals?
* What is stormwater and how will these levels affect it?
 | N/A |
| **Land elevations****ST5-2, ST5-4, ST5-5**Students:* describe measuring and capture technologies used in surveying and geospatial engineering
* engage in industry career development opportunities to gain a deeper knowledge of the surveying and geospatial engineering professions, develop skills, knowledge and understanding of authentic, real-world problem-solving opportunities
 | **Teacher**Introduce topographical surveying.Present [Leveling, Part 1 (7:54)](https://www.youtube.com/watch?v=tNRZPHLwC7k).Describe different methods for measuring land elevations.Present the first 5 minutes of [How does land surveying work? (6:25)](https://www.youtube.com/watch?v=SPCewaAfqPA).**Teacher and students**Outline the topographic survey method used in the video. Create a flowchart for the process used.Highlight the term ‘reduced levels’ as relative heights against a known line level or eye line height. | With assistance, students can outline the steps to complete a topographic survey, for example:* establishing a survey grid of datum points
* establishing a line level or eye line level
* measuring datum point height against line level or eye line level
* recording measurements
* calculating difference between line level or eye line level and datum point.
 | Review key concepts and vocabulary before viewing video. Use closed captions when viewing video to assist understanding and vocabulary building. Pause video to assess student understanding at appropriate points.Joint flowchart creation builds deep understanding of the process and assists in understanding of complex processes. |
| **Topographic survey****ST5-2, ST5-4, ST5-5**Students describe measuring and capture technologies used in surveying and geospatial engineering | **Teacher and students**Review or complete topographic surveying flowchart from last lesson.Calculate examples of reduced levels using measured height and eye line height to determine relative height.**Teacher and students**Review example [Topographic survey](http://www.georgialandsurveying.com/residential-surveys/topographic-surveys-residential/) in reference to new knowledge regarding surveying.Explore topographic survey and features it contains, for example:* heading
* legend
* area
* contour lines
* compass star
* grid bearing
* scale
* notes with equipment used
* notes with contour line intervals
* coordinates of boundary.
 | With assistance, students can outline the steps to complete a topographic survey.With assistance, students can calculate examples of reduced levels using measured height and eye line height to determine relative height.Students can identify features of a topographic survey plan.With assistance, students can use the scale on a plan to convert plan measurements into actual measurements.Students can read the contours on a topographic survey plan to determine slope and elevation. | Joint flowchart creation builds deep understanding of the process and assists in understanding of complex processes. |
| **Weekly reflection** | **Students**Complete weekly reflection using the following steps:* identify tasks undertaken, new knowledge, understanding or skills
* evaluate new knowledge, understanding or skills in light of previous knowledge
* analyse key insights and pose questions regarding their future learning.
 | Students answer reflective questions, for example:* What did I learn about surveying this week?
* Did I learn best when receiving information, applying knowledge, or communicating?
* What did I enjoy doing this week?
 | Modelling of the reflective process may assist with the metacognitive (thinking about thinking) aspects of this task.Procedural recount to be prepared on paper or digitally, including speech to text or voice recording. |

**Note:** Two options, A and B are provided. Please choose one based on availability of resources and sites with suitable topography. Option A is optimal if automatic levels are available. Option B is optimal if site is flat or automatic levels are unavailable. Allow at least 2 lessons for either option.

Table – Surveying and geospatial engineering week 6 learning sequence

|  |  |  |  |
| --- | --- | --- | --- |
| Outcomes and content | Teaching and learning | Evidence of learning | Adjustments and registration |
| **Week 6 – Field work skills****Option A: Automatic level skills****ST5-8**Students:* explore georeferencing techniques in the production of solutions to surveying and geospatial problems
* use a variety of technologies to prepare 2D and/or 3D plans
 | **Teacher**Present [Surveying 1 – Introduction to leveling (4:51)](https://www.youtube.com/watch?v=j8poe2vvD2Q).**Teacher and students**Adapt previous topographic surveying flowchart to include the set-up of an automatic level.Identify and label parts of the [automatic level](https://surveyforbeginners.wordpress.com/2018/12/17/automatic-level/) using labelled images.**Teacher**Present [Surveying 2 – Taking a level reading (5:15)](https://www.youtube.com/watch?v=YnDA-nAUyl8&list=PLDUuWSYkExUoO5y5X8DfFRMi-bL-dJAC-&index=2). Provide worksheet with method for student reference and completion in the next task.**Teacher and students**Set up automatic level outside and take simple readings with a staff to practice use of staff and automatic level. | With assistance, students can adjust topographic survey flowchart to include the use of an automatic level, for example:* set up tripod
* fix level to tripod with screw
* set level at eye height
* loosen screw to adjust bullseye level
* rotate telescope and adjust levelling screws
* rotate telescope 90-degrees and adjust levelling screw.

Students can identify the parts of an automatic level.With assistance students can set-up and use an automatic level to take staff measurements. | Use closed captions when viewing video to assist understanding and vocabulary building. Pause video to assess student understanding at appropriate points.Joint flowchart adaptation builds deep understanding of the process and assists in understanding of complex processes.Modelling equipment used to take measurements will assist in skill building.Assist with measurement recording and creation of appropriate tables. |
| **Option A: Automatic level skills****ST5-3**Students use a variety of technologies to prepare 2D and/or 3D plans | **Teacher preparation**Prepare a 10 m by 15 m area, with 5 m interval datum points, as seen in [Surveying 5 – Making a contour plan (2:41)](https://www.youtube.com/watch?v=bqpZzcIc-qg&list=PLDUuWSYkExUoO5y5X8DfFRMi-bL-dJAC-&index=5).**Teacher**Review the use of a benchmark point.Present [Surveying 5 – Making a contour plan (2:41)](https://www.youtube.com/watch?v=bqpZzcIc-qg&list=PLDUuWSYkExUoO5y5X8DfFRMi-bL-dJAC-&index=5).Explain that students will be replicating the process demonstrated in the video. Explain that one benchmark can be used by multiple automatic levels.**Teacher and students**Set up automatic level and measure the 12 datum point heights and benchmark heights. Record measurements.Calculate the relative heights of certain points in relation to the benchmark point. | With assistance, students can set up and use an automatic level to take staff measurements.With assistance, students can record and calculate heights of specified points in relation to a benchmark point. | Modelling equipment used to take measurements will assist in skill building.Assist with measurement recording and creation of appropriate tables. |
| **Option B: Small scale terrain model****ST5-3**Students use a variety of technologies to prepare 2D and/or 3D plans | **Teacher preparation**[Microsoft Excel](https://app.education.nsw.gov.au/digital-learning-selector/LearningTool/Card/104) is generally licensed and available on school computers and has the function to create surface and contour charts. Ensure available computers have the desktop version of Microsoft Excel installed or an alternative piece of software capable of creating contour charts.**Teacher**Demonstrate topographic survey of small-scale terrain model. Use a 50 mm by 50 mm grid referenced measuring system using the following materials:* ruler
* string line
* string line level
* dowel
* wooden blocks
* measuring tape
* marker
* terrain model.

**Teacher**Introduce a small-scale model of a terrain to determine elevations.Explain the use of a string line and string line level as an analogue for an automatic level (dumpy level) on a building site.**Students**Measure the ‘elevation’ height of the model against a level string line at each 50 mm by 50 mm grid reference point.Record the height at each point in a (Microsoft Excel) spreadsheet.Note: The level string line represents the eye-line height of a surveying device.Subtract measured elevation height from the eye line reference height to calculate actual elevation height.**Teacher preparation**Required at least a week in advance. Use on hand materials to create different 600 mm by 800 mm (approximately) terrain models, for example:* plywood, fabric, recyclables, and glue
* vacuum mould
* layered cardboard
* plaster mould of a rocky area
* papier-mâché, newspaper, foam, and foil.
 | Students can measure a survey grid on the small-scale model to locate datum points.Students can set up a level line over the model.Students can use equipment to measure the line level height and heights of datum points.Students can record measurements in an appropriate spreadsheet table. | Modelling equipment used to take measurements will assist in skill building.Assist with measurement recording and creation of appropriate tables. |
| **Option B: Small scale terrain model****ST5-3**Students use a variety of technologies to prepare 2D and/or 3D plans | **Teacher and students**Complete small scale topographic survey from last lesson. Ensure string line eye-line height is the same as previous lesson. | Students can measure a survey grid on the small-scale model to locate datum points.Students can set up a level line over the model.Students can use equipment to measure the line level height and heights of datum points.Students can record measurements in an appropriate table. | Use closed captions when viewing video to assist understanding and vocabulary building. Pause video to assess student understanding at appropriate points.Modelling equipment used to take measurements will assist in skill building.Assist with measurement recording and creation of appropriate tables. |
| **Create digital 3D model****ST5-4, ST5-6, ST5-8, ST5-9**Students use a variety of technologies to prepare 2D and/or 3D plans | **Teacher and students**Insert data from either option A or option B into a (Microsoft Excel) spreadsheet.Create a 3D surface chart, contour chart, and wireframe contour chart from the survey data.**Teacher**Provide scaffolded template for topographic survey plan.**Teacher and students**Insert wireframe contour chart from Microsoft Excel spreadsheet into topographic survey plan scaffold.**Extension (optional)**Examine the mathematical thinking in this tutorial on [creating a complicated contour map in Microsoft Excel (11:57)](https://www.youtube.com/watch?v=8aOyjgc0O_U). | Students can identify and select the most suitable (and available) software to use to create contour charts.Students will be able to follow the demonstrated steps and can record measurements in a spreadsheet.Students can create a wireframe contour chart.Students can insert a chart in a word processing document.Students can edit a word processing document. | Model the creation of a spreadsheet table and give clear instructions of chart creation.Create a template worksheet if scaffolding of spreadsheet task is required. |
| **Weekly reflection** | **Students**Complete weekly reflection using the following steps:* identify tasks undertaken, new knowledge, understanding or skills
* evaluate new knowledge, understanding or skills in light of previous knowledge
* analyse key insights and pose questions regarding their future learning.
 | Students answer reflective questions, for example:* What did I learn about surveying this week?
* Did I learn best when receiving information, applying knowledge, or communicating?
* What did I enjoy doing this week?
 | Modelling of the reflective process may assist with the metacognitive (thinking about thinking) aspects of this task.Procedural recount can be prepared on paper or digitally, including speech to text or voice recording. |

### Weeks 7 and 8

**Note:** In Week 7, 2 options, A and B are provided. Please choose one based on availability of resources and sites with suitable topography.

Table – Surveying and geospatial engineering week 7 learning sequence

|  |  |  |  |
| --- | --- | --- | --- |
| Outcomes and content | Teaching and learning | Evidence of learning | Adjustments and registration |
| **Week 7 – Field work****Option A: Topographic survey****ST5-1, ST5-2, ST5-3, ST5-4, ST5-5, ST5-6, ST5-7, ST5-9**Students:* design and build a system to solve a real-world surveying and geospatial engineering problem
* explore georeferencing techniques in the production of solutions to surveying and geospatial problems
* apply fundamental mathematical techniques related to the surveying and geospatial professions
* use a variety of technologies to prepare 2D and/or 3D plans
* develop an understanding of surveying and the geospatial engineering professions
* investigate the nature of the work and pathways into surveying and geospatial engineering professions
* demonstrate innovation and entrepreneurial activity in communicating solutions to problems involving surveying and geospatial engineering
* work individually and collaboratively to apply an engineering design process to complete surveying or geospatial challenges and problems
 | **Teacher preparation**Choose an irregular or sloped ‘building plot’ for a field work topographic survey. This can be the same as the plot used earlier.**Teacher**Revise method for conducting a topographic survey.Revise example [Topographic survey](http://www.georgialandsurveying.com/residential-surveys/topographic-surveys-residential/).Discuss and demonstrate topographic survey students will create and features it should contain, for example:* heading
* legend
* area
* spot height
* contour lines
* compass star (North point)
* grid bearing
* scale
* notes with equipment used
* date
* surveyor’s name
* notes with contour line intervals
* coordinates of boundary measurements and bearings from boundary corners to designated feature.

Explain location, size, and intervals of a lot that will be used for surveying elevation and land features.**Teacher and students**Establish a benchmark near the plot. Use the **NSW Elevation and Depth Theme – Contour** widget in ‘Spatial map viewer’ to find a contour line intersecting a stable landmark near the plot. Use this contour to find elevation of that benchmark. Use the **Coordinate Tool** in ‘SIX Maps’ to find the coordinates of this landmark/benchmark.This can also be achieved with commercial GPS devices and smartphone applications.Conduct survey of the chosen site using appropriate materials, for example:* auto level/construction level/dumpy level
* telescopic staff
* measuring tape
* survey flags, chalk, or line marking paint
* chaining pins or plastic tee plant markers
* laptop
* string line
* string line level
* plastic tubing.

Record measurements into pre-prepared Microsoft Excel workbook.The ‘benchmark’ can be set before the lesson or the ‘school survey mark’ from previous lesson can be reused.For further information see [Creating Contour Maps (14:58)](https://www.youtube.com/watch?v=cpUVV7P9Xo4). | With assistance, students can set up and use an automatic level to take staff measurements at datum points.With assistance, students can record and calculate heights of specified points in relation to a benchmark point. | Adjust activity based on school context, grounds, safety, resources, accessibility, and individual student needs.Model the use of measuring equipment and software.Provide scaffolds and templates of documents based on student needs and the desired level of student independence, for example:* spreadsheet table and charts that require varied measurement input
* topographic survey plan with certain missing pieces
* shadow diagram template with structure drawing and compass rose in place.

Use magnetic north without declination adjustment to enhance accessibility of activity if using bearings. |
| **Option A: Topographic survey****ST5-1, ST5-2, ST5-3, ST5-4, ST5-5, ST5-6, ST5-7, ST5-9**Students:* design and build a system to solve a real-world surveying and geospatial engineering problem
* explore georeferencing techniques in the production of solutions to surveying and geospatial problems
* apply fundamental mathematical techniques related to the surveying and geospatial professions
* use a variety of technologies to prepare 2D and/or 3D plans
* develop an understanding of surveying and the geospatial engineering professions
 | **Teacher and students**Continue survey of the chosen site using appropriate materials.Record measurements into pre-prepared Microsoft Excel spreadsheet. | With assistance, students can set up and use an automatic level to take staff measurements at datum points.With assistance, students can record and calculate heights of specified points in relation to a benchmark point. | Adjust activity based on school context, grounds, safety, resources, accessibility, and individual student needs.Model the use of measuring equipment and software.Provide scaffolds and templates of documents based on student needs and the desired level of student independence, for example:* spreadsheet table and charts that require varied measurement input
* topographic survey plan with certain missing pieces
* shadow diagram template with structure drawing and compass rose in place.

Use magnetic north without declination adjustment to enhance accessibility of activity if using bearings. |
| **Option A: Topographic survey****ST5-1, ST5-2, ST5-3, ST5-4, ST5-5, ST5-6, ST5-7, ST5-9**Students:* design and build a system to solve a real-world surveying and geospatial engineering problem
* use a variety of technologies to prepare 2D and/or 3D plans
 | **Teacher and students**Complete topographic survey from last lesson.Use Microsoft Excel to create a 3D surface chart, contour chart and wireframe contour chart from the survey data.**Teacher**Provide scaffolded template of topographic survey plan.**Students**Insert wireframe contour chart from Microsoft Excel into topographic survey plan scaffold. Complete topographic survey plan features. | Students can record measurements in an appropriate spreadsheet program.Students can create a wireframe contour chart.Students can insert a chart in a word processing document.Students can edit a word processing document to produce an example topographic survey plan. | Adjust activity based on school context, grounds, safety, resources, accessibility, and individual student needs.Model the use of measuring equipment and software.Provide scaffolds and templates of documents based on student needs and the desired level of student independence.Use magnetic north without declination adjustment to enhance accessibility of activity if using bearings. |
| **Option B: Shadow diagrams****ST5-1, ST5-2, ST5-3, ST5-4, ST5-5, ST5-6, ST5-7, ST5-9**Students:* design and build a system to solve a real-world surveying and geospatial engineering problem
* use a variety of technologies to prepare 2D and/or 3D plans
 | **Teacher**Explore the rotation of the Earth and the perceived movement of the Sun. Relate this to the change in shadows during the day.Review shadow diagrams. Use public access council development applications (DA) or search for applications on exhibition, for example:* [Survey examples](http://www.georgialandsurveying.com/survey-examples/)
* [NSW planning portal](https://www.planning.nsw.gov.au/About-Us/NSW-Planning-Portal)
* [City of Sydney](https://www.cityofsydney.nsw.gov.au/development-applications/search-development-applications)
* [Lake Macquarie City](https://property.lakemac.com.au/ePathway/Production/Web/GeneralEnquiry/EnquiryLists.aspx).

Note: Shadow diagrams can be separate documents or found within architectural drawings.Explain shadow diagrams to students. Identify certain features, for example:* compass rose with true north
* shadows represented over times of the day
* structure central to the diagram
* scale
* key.

**Teacher and students**Identify a school structure that will be the focus of this shadow diagram activity. The shadow diagram produced will document the time of year that this activity occurs.Prepare reference points/grid reference around chosen structure using appropriate materials, for example:* measuring tape
* angle measurer
* chalk
* line marking paint.

Mark and measure the current shadow as a reference.Prepare a method for photographing/recording the shadow at 9 am, 12 pm, and 3 pm, for example:* measurements at each time
* marking the ground at each time
* video
* timelapse photography
* staff member or student with a camera.
 | Students can identify the source of shadows and describe why shadows change during the day.Students can identify a shadow diagram and describe representations and features, for example:* where a shadow will fall at 9 am
* compass directions
* movement of shadows during the day.

With assistance, students develop a method for recording the change in shadows during the day. | Adjust activity based on school context, grounds, safety, resources, accessibility, and individual student needs.Model the use of measuring equipment and software.Provide scaffolds and templates of documents based on student needs and the desired level of student independence.Use magnetic north without declination adjustment to enhance accessibility of activity if using bearings. |
| **Option B: Shadow diagrams****ST5-1, ST5-2, ST5-3, ST5-4, ST5-5, ST5-6, ST5-7, ST5-9**Students:* design and build a system to solve a real-world surveying and geospatial engineering problem
* use a variety of technologies to prepare 2D and/or 3D plans
 | **Teacher and students**Take measurements for the creation of your shadow diagram.Measure the structure’s ‘footprint’. This will form the structural part of the shadow diagram.Use measurements, photographs, or recordings to determine the position of a shadow at chosen times.Use measurements to begin sketching the shadow diagram. | Students are able to measure and record the change in shadows during the day.Students can use equipment to measure and record dimensions of a structure within reasonable tolerances.Students can use technologies to prepare a shadow diagram. | Modelling equipment used to take measurements will assist in skill building.Assist with measurement recording and creation of appropriate tables. |
| **Option B: Shadow diagrams****ST5-1, ST5-2, ST5-3, ST5-4, ST5-5, ST5-6, ST5-7, ST5-9**Students:* design and build a system to solve a real-world surveying and geospatial engineering problem
* use a variety of technologies to prepare 2D and/or 3D plans.
 | **Teacher**Assist students with measuring and recording.Remind students about shadow diagram features.**Students**Complete creation of shadow diagram.Use measurements, photographs, or recordings to determine the position of a shadow at certain times.Use measurements to complete the final shadow diagram. Include a scale, key, and compass rose.**Extension (optional)**Use aerial imagery software to view the structure used in the shadow diagram. Hypothesise the time of day and year the aerial image may have been taken.Investigate how shadow diagrams are calculated for the summer and winter solstice. | Students can record measurements in an appropriate format.Students can edit a word processing document to include shadow diagram features, for example:* shadow position at different times
* key
* scale
* compass rose.
 | Adjust activity based on school context, grounds, safety, resources, accessibility, and individual student needs.Model the use of measuring equipment and software.Provide scaffolds and templates of documents based on student needs and the desired level of student independence.Use magnetic north without declination adjustment to enhance accessibility of activity if using bearings. |
| **Weekly reflection** | **Students**Complete weekly reflection using the following steps:* identify tasks undertaken, new knowledge, understanding or skills
* evaluate new knowledge, understanding or skills in light of previous knowledge
* analyse key insights and pose questions regarding their future learning.
 | Students answer reflective questions, for example:* What did I learn about surveying this week?
* Did I learn best when receiving information, applying knowledge, or communicating?
* What did I enjoy doing this week?
 | Modelling of the reflective process may assist with the metacognitive (thinking about thinking) aspects of this task.Procedural recount can be prepared on paper or digitally, including speech to text or voice recording. |

Table – Surveying and geospatial engineering week 8 learning sequence

|  |  |  |  |
| --- | --- | --- | --- |
| Outcomes and content | Teaching and learning | Evidence of learning | Adjustments and registration |
| **Week 8****Boundaries****ST5-1, ST5-2, ST5-3, ST5-4, ST5-5, ST5-6, ST5-7, ST5-9**Students:* design and build a system to solve a real-world surveying and geospatial engineering problem
* explore georeferencing techniques in the production of solutions to surveying and geospatial problems
* apply fundamental mathematical techniques related to the surveying and geospatial professions
* use a variety of technologies to prepare 2D and/or 3D plans
* develop an understanding of surveying and the geospatial engineering professions
* investigate the nature of the work and pathways into surveying and geospatial engineering professions
* work individually and collaboratively to apply an engineering design process to complete surveying or geospatial challenges and problems
* demonstrate innovation and entrepreneurial activity in communicating solutions to problems involving surveying and geospatial engineering
 | **Teacher preparation**Choose a ‘building plot’. Safely mark corners with hidden pegs for later reference.**Teacher**Introduce cadastral boundary surveying task.Distinguish between licenced and registered surveyors and non-licenced and registered surveyors.View example [Boundary survey [PDF 1.13MB]](http://www.georgialandsurveying.com/wp-content/uploads/2011/04/Boundary-Surveys-Example1.pdf).Discuss and demonstrate boundary survey. Students are to create and include features it contains, for example:* heading
* legend
* area
* compass star
* grid bearing
* scale
* notes with equipment used
* coordinates of boundary
* measurements and bearings from boundary corners to designated feature.

Introduce specific hypothetical building plot challenge. Give bearings and measurements from selected school ‘cadastral monuments’, ‘school survey marks’, or reference points.**Students**In groups, use given bearings and measurements to mark out selected ‘building plot’.Use various equipment to find and mark the plot, for example:* measuring tapes
* compasses
* GPS
* automatic level
* survey flags, chalk, or line marking paint
* angle ruler or measurer.

**Teacher**Prompt students to use the boundaries of this plot to determine the exact bearing and distance from points on this boundary to designated features of the area, for example:* determine the bearing and distance from the north-west corner of the plot to the fire hydrant
* determine the bearing and distance from the south-east corner of the plot to the north-west corner of D block.
 | Students can identify and describe features of a boundary survey.Students can use equipment to determine bearings and measure distances.Students can recall that only registered and licensed surveyors can sign identification, boundary marking plans and deposited plans for boundaries (it can be marked by technicians under supervision of registered and licensed surveyors). | Adjust activity based on school context, grounds, safety, resources, accessibility, and individual student needs.Model the use of measuring equipment.Provide scaffolds and templates of documents based on student needs and the desired level of student independence, for example:* template with hypothetical boundary in place – students only need to add measurements and bearings
* template with aerial imagery to assist with orientation of ground features.

Use magnetic north without declination adjustment to enhance accessibility of activity if using bearings. |
| **Boundaries****ST5-1, ST5-2, ST5-3, ST5-4, ST5-5, ST5-6, ST5-7, ST5-9**Students:* design and build a system to solve a real-world surveying and geospatial engineering problem
* explore georeferencing techniques in the production of solutions to surveying and geospatial problems
 | **Students**Continue land surveying boundary task from last lesson.**Teacher**Assist students with measuring and recording.Remind students about boundary survey features, for example:* heading
* legend
* area
* compass star
* grid bearing
* scale
* notes with equipment used
* coordinates of boundary
* measurements and bearings from boundary corners to designated feature.

**Students**Document the method used.Mark boundary corners using survey flags.Create a boundary survey document showing plot location.Answer questions posed to orient boundary within school dimensions.Use imagery from previously used GISs to assist with map creation. | Students can use equipment to determine bearings and measure distances.Students can accurately locate survey points within the context of given features or reference points.Students can record and document measurements in an appropriate boundary survey document. | Adjust activity based on school context, grounds, safety, resources, accessibility, and individual student needs.Model the use of measuring equipment.Provide scaffolds and templates of documents based on student needs and the desired level of student independence, for example:* template with hypothetical boundary in place – students only need to add measurements and bearings
* template with aerial imagery to assist with orientation of ground features.

Use magnetic north without declination adjustment to enhance accessibility of activity if using bearings. |
| **Boundaries****ST5-1, ST5-2, ST5-3, ST5-4, ST5-5, ST5-6, ST5-7, ST5-9**Students:* design and build a system to solve a real-world surveying and geospatial engineering problem
* explore georeferencing techniques in the production of solutions to surveying and geospatial problems
 | **Students**Complete land surveying boundary task from last lesson.Prepare boundary survey document.**Teacher**Assist students with measuring and recording.Assist students with boundary survey features, for example:* heading
* legend
* area
* compass star
* grid bearing
* scale
* notes with equipment used
* coordinates of boundary
* measurements and bearings from boundary corners to designated feature.
 | Students can use equipment to determine bearings and measure distances.Students can accurately locate survey points within the context of given features or reference points.Students can record and document measurements in an appropriate boundary survey document. | Adjust activity based on school context, grounds, safety, resources, accessibility, and individual student needs.Model the use of measuring equipment.Provide scaffolds and templates of documents based on student needs and the desired level of student independence, for example:* template with hypothetical boundary in place – students only need to add measurements and bearings
* template with aerial imagery to assist with orientation of ground features.

Use magnetic north without declination adjustment to enhance accessibility of activity if using bearings. |
| **Weekly reflection** | **Students**Complete weekly reflection using the following steps:* identify tasks undertaken, new knowledge, understanding or skills
* evaluate new knowledge, understanding or skills in light of previous knowledge
* analyse key insights and pose questions regarding their future learning.
 | Students answer reflective questions, for example:* What did I learn about surveying this week?
* Did I learn best when receiving information, applying knowledge, or communicating?
* What did I enjoy doing this week?
 | Modelling of the reflective process may assist with the metacognitive (thinking about thinking) aspects of this task.Procedural recount to be prepared on paper or digitally, including speech to text or voice recording. |

### Weeks 9 and 10

Table – Surveying and geospatial engineering weeks 9 and 10 learning sequence

|  |  |  |  |
| --- | --- | --- | --- |
| Outcomes and content | Teaching and learning | Evidence of learning | Adjustments and registration |
| **Week 9 – Past to the future****ST5-5**Students outline historical perspectives in surveying and geospatial engineering that have impacted society | **Teacher**Introduce and present [Wurdi Youang (3:38)](https://www.youtube.com/watch?v=RMdLNqt2XrI). Outline the use of stone arrangements to mark times in the year, for example:* winter solstice
* summer solstice.

**Teacher and students**Present parts of [Wurdi Youang: An Australian Aboriginal stone arrangement with possible solar indications [PDF 5.12MB]](http://www.aboriginalastronomy.com.au/wp-content/uploads/2020/02/Hamacher-2012-Wurdi-Youang.pdf).Extract the uses of stone monuments, for example:* to mark the passage of time from midsummer to midwinter
* as landmarks
* to gauge position
* to tell direction
* boundaries
* ceremonial.

**Teacher**Explore student cultural knowledge and/or use clips from various articles to see how various cultures have used stone monuments for position, direction, or boundaries, for example:* [Ancient alignments](https://www.scientificamerican.com/article/ancient-alignments/)
* [Megaliths? Megacool](https://asd.gsfc.nasa.gov/blueshift/index.php/2010/06/30/faiths-blog-megaliths-megacool/).

Explain the importance of diverse cultural perspectives and how they can inspire creativity and drive innovation. | Students demonstrate understanding of cultural significance of stone monuments.Students understand that different peoples have cultural methods of measuring time, distance, direction, and position. | Use closed captions when viewing this alternative video [Aboriginal Astronomy (3:18)](https://www.youtube.com/watch?v=Wv8hKMj6ikA).Pause video to assess student understanding at appropriate points.Joint reading of significant parts of chosen text to create outline of key terms.Model strategies that assist understanding if reading complicated texts (professional articles), for example:* explicit breakdown of titles, headings, and keywords
* focus on key paragraphs pertinent to the topic
* highlight key sentences pertaining to the uncertainty surveyors face
* highlight key sentences highlighting the important role surveyors have.
 |
| **LiDAR****ST5-5**Students:* discuss methodologies surveyors use to provide confidence in their measurements and inform their decisions or professional judgements
* explore georeferencing techniques in the production of solutions to surveying and geospatial problems
* describe measuring and capture technologies used in surveying and geospatial engineering
* explore emerging technologies related to surveying and geospatial professionals
* investigate the nature of the work and pathways into surveying and geospatial engineering professions
 | **Teacher**Introduce emerging technologies in surveying and geospatial engineering, for example:* LiDAR
* point cloud
* photogrammetry.

Present [How Does LiDAR Remote Sensing Work? (7:44)](https://www.youtube.com/watch?v=EYbhNSUnIdU).**Teacher and students**Discuss how LiDAR aerial imaging can be used for large scale mapping and surveying.Document a summary of the LiDAR aerial imaging process**Teacher**Present [What is LiDAR Drone Surveying (11:30)](https://www.youtube.com/watch?v=aaPJNX0Cy4c). Pause and discuss the video at emphasis points, for example:* use of ground control points
* zooming on specific individual points in point cloud
* presenter pointing out methods to help ensure accuracy and precision.
 | Students can identify and briefly describe emerging technologies in surveying and geospatial engineering.Students are able to describe the basic concepts of LiDAR and how a LiDAR unit (or main component) operates.Students are able to describe the basic concepts of a point cloud, how it can be represented, and how a viewer can interact with a point cloud instance. | Review key concepts and vocabulary before viewing video. Use closed captions when viewing video to assist understanding and vocabulary building. Pause video to assess student understanding at appropriate points.Provide worksheet with key terms to assist with vocabulary building and knowledge acquisition. |
| **LiDAR****ST5-5**Students:* discuss methodologies surveyors use to provide confidence in their measurements and inform their decisions or professional judgements
* explore georeferencing techniques in the production of solutions to surveying and geospatial problems
* describe measuring and capture technologies used in surveying and geospatial engineering
* engage in industry career development opportunities to gain a deeper knowledge of the surveying and geospatial engineering professions, develop skills, knowledge and understanding of authentic, real-world problem-solving opportunities.
 | **Teacher**Present [Land Surveying with Drone LiDAR (12:13)](https://www.youtube.com/watch?v=2E_6JE-MNeM). Pause and discuss the video at emphasis points, for example:* supporting allied professionals
* the speed of drone LiDAR capture
* the safety of LiDAR capture
* LiDAR is used to augment surveying methods
* how LiDAR capture accuracy is tested.

**Teacher and students**Highlight the use of survey marks and GPS to improve accuracy of LiDAR measurements.Emphasise the use of LiDAR to augment and not replace other surveying methods. | With assistance, students can identify LiDAR as a technology that can augment conventional surveying methods.Students can identify benefits and limitations of LiDAR. | Review key concepts and vocabulary before viewing video. Use closed captions when viewing video to assist understanding and vocabulary building. Pause video to assess student understanding at appropriate points.Provide worksheet with key terms to assist with vocabulary building and knowledge acquisition. |
| **Weekly reflection** | **Students**Complete weekly reflection using the following steps:* identify tasks undertaken, new knowledge, understanding or skills
* evaluate new knowledge, understanding or skills in light of previous knowledge
* analyse key insights and pose questions regarding their future learning.
 | Students answer reflective questions, for example:* What did I learn about surveying this week?
* Did I learn best when receiving information, applying knowledge, or communicating?
* What did I enjoy doing this week?
 | Modelling of the reflective process may assist with the metacognitive (thinking about thinking) aspects of this task.Procedural recount to be prepared on paper or digitally, including speech to text or voice recording. |
| **Week 10 - Point clouds and reality 3D mesh****ST5-5**Students:* discuss methodologies surveyors use to provide confidence in their measurements and inform their decisions or professional judgements
* explore georeferencing techniques in the production of solutions to surveying and geospatial problems
* describe measuring and capture technologies used in surveying and geospatial engineering
* develop an understanding of surveying and the geospatial engineering professions
* investigate the nature of the work and pathways into surveying and geospatial engineering professions.
 | **Teacher**Present [What are Point Clouds, And How Are They Used? (3:01)](https://www.youtube.com/watch?v=yXCkyuo8bcs).Explain how photogrammetry and LiDAR are used to create point clouds and to create 3D reality meshes.**Teacher and students**Use ‘NSW Spatial Digital twin’ to view Fort Denison as a 3D reality mesh.Open [Digital twin](https://nsw.digitaltwin.terria.io/).Select ‘map settings’ and choose NSW aerial imagery.Select ‘explore map data’. Scroll down to ‘NSW Digital twin featured data’. Open and select ‘Reality meshes’. Choose ‘Fort Denison 3D model’.Select ‘Ideal zoom’ to auto navigate to Fort Denison.**Students**Explore the mesh slowly, rendering takes time. Learn how to navigate the space.Complete the following tasks:* find the coordinates of the black and white ground control tiles
* find the South-East cannon. Measure the length of the barrel
* measure the width of the southerly stair well steps.

**Teachers and students**Identify the benefits and limitations of 3D reality meshes and point clouds. | With assistance, students can describe a point cloud and the benefits of using them.Students demonstrate capability in navigating GIS systems.Students can interpret structures and details from 3D reality mesh, for example:* coordinates
* measurements.
 | Review key concepts and vocabulary before viewing video. Use closed captions when viewing video to assist understanding and vocabulary building. Pause video to assess student understanding at appropriate points.Provide worksheet with key terms to assist with vocabulary building and knowledge acquisition.Model coordinate finding and measuring tool use on ‘Digital twin’. |
| **Photogrammetry****ST5-5*** discuss methodologies surveyors use to provide confidence in their measurements and inform their decisions or professional judgements
* explore georeferencing techniques in the production of solutions to surveying and geospatial problems
* describe measuring and capture technologies used in surveying and geospatial engineering
* investigate the nature of the work and pathways into surveying and geospatial engineering professions
 | **Teacher and students**Use a photogrammetry app or program to create and explore a 3D scan of previously measured structures, plots, or models, for example:* building measured with trigonometry
* small scale terrain model
* topographic survey plot.

Compare measurements from this 3D model to the models created earlier in the topic.Compare different surveying methodologies explored in the topic, for example:* automatic level surveying
* LiDAR
* photogrammetry.
 | With assistance students can describe photogrammetry and some of its uses.Students can interpret structures and details from photogrammetry 3D renderings, for example:* measurement of structures
* distances
* slope.
 | N/A |
| **Industry connections****ST5-10**Students engage in industry career development opportunities to gain a deeper knowledge of the surveying and geospatial engineering professions, develop skills, knowledge and understanding of authentic, real-world problem-solving opportunities. | **Teacher and students**Explore the webpage [Demand for Surveyors](https://www.alifewithoutlimits.com.au/increased-demand-for-surveyors/). Examine the opportunities and pathways for surveying.Engage in [surveying and geospatial engineering career](https://www.alifewithoutlimits.com.au/blog/explore-the-rmit-geospatial-sciences-tour/) resources. | Students can discuss careers and pathways to entry into surveying and geospatial engineering. | N/A |
| **Weekly reflection** | **Students**Complete weekly reflection using the following steps:* identify tasks undertaken, new knowledge, understanding or skills
* evaluate new knowledge, understanding or skills in light of previous knowledge
* analyse key insights and pose questions regarding their future learning.
 | Students answer reflective questions, for example: * What did I learn about surveying this week?
* Did I learn best when receiving information, applying knowledge, or communicating?
* What did I enjoy doing this week?
 | Modelling of the reflective process may assist with the metacognitive (thinking about thinking) aspects of this task.Procedural recount to be prepared on paper or digitally, including speech to text or voice recording. |

## Additional information

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/557), [Kahoot](https://kahoot.com/), [Socrative](https://www.socrative.com/), [Quizlet](https://quizlet.com/) 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). 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.
* 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/564).

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.

[CESE What works best update 2020](https://policies.education.nsw.gov.au/content/dam/main-education/about-us/educational-data/cese/wwb-what-works-best-2020-update.pdf)

### 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/primary-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 culture. 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/enhanced-teaching-and-learning-cycle).
* **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 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 and subject specific curriculum considerations can be found on the [Inclusive Practice hub](https://education.nsw.gov.au/campaigns/inclusive-practice-hub/primary-school/teaching-strategies/differentiation).
* **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 helps 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.

### 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.

**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 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](https://education.nsw.gov.au/teaching-and-learning/curriculum/department-approved-courses/istem#/asset2) © 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**: ST-1, ST-2, ST-3, ST-4, ST-5, ST-6, ST-7, ST-8, ST-9, ST-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, Consulting Surveyors NSW, and UNSW

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

**Creation date**: 20 October 22

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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, p 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, p 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, 2020, p 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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