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| INVESTIGATION | **MATHEMATICS** |
|  | **Level 5** |

# Town planning

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| BD05297_**Strand** | **Topics** |
| **Space** | Shape and line  Location, direction and movement |
| **Outcomes S 5.1, S 5.2** | |

## Investigation

You are a town planner and one of your tasks is to design and build a model of the centre of a planned city. The centre must meet the needs of a small community, be useful to its citizens and use a variety of shapes to provide an interesting landscape. You will be required to present your design and model to an audience.

## Overview

The following table shows how this investigation is organised in phases associated with **thinking, reasoning and working mathematically.**

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| Thinking, reasoning and working mathematically | | | | |
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| 1. Identifying and describing |  | 2. Understanding and applying |  | 3. Communicating and justifying |
| Introducing the investigation  Students:  clarify the requirements of the culminating presentation  investigate features of planned city centres.  Looking at the local area  Students:  examine their local area to identify building shapes and locations.  Looking at a planned city  Students:  locate and examine planned cities to develop an understanding of town planning. |  | Applying the knowledge  Students:  begin to design their own city precinct  use knowledge of scale to create a plan of the city centre.  Building the model  Students:  construct scale models of buildings  examine the properties of shapes  use compass bearings to describe the outlook and location of buildings. |  | Presenting the model to  the class  Students:  justify their choices of materials and overall designs  refer to mandatory building regulations  discuss the scale and size of the proposed city centre.  Feedback  Students:  receive feedback from their teacher, peers and others. |

## Core learning outcomes

This investigation focuses on the following core learning outcomes from the *Years 1 to 10 Mathematics Syllabus*:

**S 5.1** Students analyse the relationships between the properties of shapes, lines and angles to explain similarity and congruence and to create representations of geometric objects that satisfy design specifications.

**S 5.2** Students interpret maps and globes referring to latitude and longitude, interpret and describe plans that use scale and describe movements using compass bearings and distance.

Using this investigation

The sequence of activities suggested in this investigation provides opportunities for students to demonstrate learning described by core learning outcomes or aspects of core learning outcomes. The investigation may be modified to provide opportunities for students to demonstrate learning described by core learning outcomes at other levels.

Contribution to the attributes of a lifelong learner

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| **Knowledgeable person with deep understanding** | Students apply their knowledge of space to design a city centre and explain their choices of materials and overall designs. |
| **Complex thinker** | Students build on prior knowledge and incorporate new information about 2D and 3D shapes, maps and plans to fulfil the requirements of the investigation. |
| **Responsive creator** | Students creatively design a city centre using their knowledge of mathematics. |
| **Active investigator** | Students think of and explain ways to plan a city centre that is structurally sound, aesthetically pleasing and functional. |
| **Effective communicator** | Students present and explain their model to an audience, and justify their decisions about the sizes, shapes and positions of buildings and the location of the city centre they have designed. They listen to others and provide feedback. |
| **Participant in an interdependent world** | Students take responsibility for their own mathematical actions and decisions. They show consideration of others when they work in groups and provide feedback to their peers. |
| **Reflective and  self-directed learner** | Students draw on what they know and can do to investigate new ideas.  To enhance their learning, they reflect on their own and others’ decisions. |

Core content

Core content in black text only is included in this investigation.

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| Space — Shape and line: Level 5 | Space — Location, direction and movement: Level 5 |
| 3D shapes and objects and 2D shapes   * plans and elevations * compound shapes * embedded shapes   Geometric terms and properties   * similarity * similar shapes (reductions and enlargements) * congruence * symbol for labelling * scale plans   Visualisations and representations   * conventions for representing 3D shapes (perspective) * sections and cross-sections   Lines and angles   * external angles * simple constructions using geometric tools * perpendicular line (90 degrees) * angle of 60 degrees * bisect a line | Location and movement   * conventions * scale on maps expressed as a simple ratio (e.g. 1:10; 1:1000) * coordinates * latitude and longitude expressed in whole degrees * location of points and places using latitude and longitude * distance and bearing (local environment) * maps * flat maps including world, atlas, street directory and orthophoto * globes * simple floor plans with scale   Direction and angle   * bearings in whole degrees (measured clockwise from north) * estimation of bearings in degrees * application of scales to maps to find actual distances |

## Resources

* street directories
* maps of planned cities
* computer-aided design programs
* materials for construction

Identifying and describing

### Introducing the investigation

Students listen to an explanation of the investigation and the task requirements. This may be provided in the following way:

‘You are a town planner and one of your tasks is to design and build a model of the centre of a planned city. The centre must meet the needs of a small community, be useful to its citizens and use a variety of shapes to provide an interesting landscape.’

Your presentation must justify the decisions you have made regarding:

* building shapes — structure, function and aesthetics
* locations of buildings, facilities and services — for example, the location of emergency services and parks
* building restrictions and regulations — for example, height restrictions.

Students:

* investigate the structures of planned cities — for example, Canberra, Adelaide, Springfield and Forest Lake (Brisbane) — and describe the locations of various features
* analyse a town plan in terms of facilities, roads and open spaces
* investigate environmentally friendly building principles and associated structural shapes
* access local council building regulations and other associated planning or building rules, laws or policies
* identify and discuss different types of buildings and their purposes
* investigate land usage in the local area to identify industrial, commercial and residential locations.

### Looking at the local area

Students:

* use the grid references in a street directory to locate areas of interest or building locations in their suburb or local area
* make assumptions about why the suburb or local area has been planned in the way it has
* revise and clarify what they already know about 3D shapes
* identify key buildings in the suburb or local area and classify them according to shape, similarity and congruence.

### Looking at a planned city

Students:

* individually or in small groups identify a number of planned cities and locate these on flat maps or globes. Record the coordinates of these cities using latitude and longitude expressed in whole degrees.
* locate planned cities identified by other groups or individuals using the coordinates provided and find the distance of these cities from the nearest major city
* examine a scale map of a planned city and locate important buildings, services or features such as hospitals, schools, emergency services, parks or sewage works
* calculate the distances between particular buildings or locations — for example, calculate how far the fire brigade is from the school or the distance from the airport to the city centre, and make conjectures regarding the choices planners may have made when designing the city.

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| Assessing learning |
| Sources of evidence could include:   * classifications of shapes used in buildings * recordings of grid references * calculations of distances between locations using scales on maps.   When making judgments, teachers consider whether the student has:   * identified relationships between the properties of shapes, lines and angles * interpreted maps and globes using latitude and longitude * interpreted scale on plans. |

## Understanding and applying

### Applying the knowledge

Students:

* design their own city centre using the information gathered from their analyses of the local area and a planned city. They:
* use drawing instruments and materials or computer-aided design programs to create   
  the plan
* decide on the shapes to be used for important buildings and identify the properties of the shapes chosen
* use knowledge of scale to create the plan.

### Building the model

Students:

* select appropriate materials to build their models
* represent the size of each building based on the scale used in the plan
* identify and analyse the relationships between properties of shapes, lines and angles to construct 3D shapes
* use shapes within shapes to create interesting building designs
* represent the distances between key buildings — for example, the distance of emergency services from the hospital
* use compass bearings to describe the outlook of each main building
* construct 3D representations of key buildings to place on a simple scale model
* use compass bearings and calculations of distance to describe the pathways from one building or location to another.

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| Assessing learning |
| Sources of evidence could include:   * representations of a city centre.   When making judgments, teachers consider whether the student has:   * identified similarity of figures as the same shape but different size * interpreted scale on plans * analysed the relationships between properties of shapes, lines and angles * described movements using compass bearings and distance * created representations of geometric objects that satisfy design specifications. |

Communicating and justifying

### Presenting the model to the class

When presenting the model to the class or other audiences, students:

* identify building shapes and justify their choices
* discuss building locations and give reasons for these
* show how mandatory building regulations have been considered when planning
* discuss the scale of the model, and the size and location of the proposed city centre.

Students form small groups to complete peer-assessment sheets during presentations by   
group members.

### Feedback

Students:

* receive feedback from their peers, teacher and others such as town planners or architects regarding the effectiveness of their model
* pose and/or answer questions about aspects of the planning that may have not   
  been discussed.

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| Assessing learning |
| Sources of evidence could include:   * presentation of model to the class * peer-assessment sheets * class discussions.   When making judgments, teachers consider whether the student has:   * identified congruence of figures as the same shape and size * identified the difference between similarity and congruence * interpreted scale on plans. |

Links

This investigation could be connected to core learning outcomes from other key learning areas   
— for example, Studies of Society and Environment and Technology.

### Studies of Society and Environment

**Strand** Place and space

**PS 5.2** Students design strategies for evaluating environmental impacts of a proposed project, highlighting relationships within and between natural systems.

Students:

* consider and evaluate possible environmental impacts
* develop criteria for evaluating impacts.

For more information, refer to the elaborations in the *Years 1 to 10 SOSE Sourcebook Guidelines,* which are available online from the QSA website: www.qsa.qld.edu.au

### Technology

**Strands** Technology Practice (5.1, 5.2, 5.3, 5.4) and Materials (5.1, 5.2)

Students:

* identify characteristics of materials that make them suitable for meeting a standard
* base their selection of materials to meet standards on comparisons of the materials’ characteristics.

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