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| INVESTIGATION | **MATHEMATICS** |
|  | **Levels 5 and 6** |

# Finding seven treasures

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| j0303313**Strands** | **Topics** |
| **Measurement** | Time |
| **Space** | Location, direction and movement |
| **Outcomes M 5.2, M 6.2, S 5.2, S 6.2** | |

## Investigation

Students investigate national and international time zones and find out how time zones can affect communication and the amount of time that has to be allowed for travel. They complete the investigation by participating in the following culminating tasks in the final phase of this investigation:

### Students working towards Level 6

International treasure hunters have approached your travel agency and asked you to develop a travel itinerary to guide their journey around the world to gather seven treasures. You are to design the itinerary to ensure that the treasure hunters visit each of the destinations where the treasures are located. The treasure hunters have 21 days to complete the collection.

The treasure hunters will need:

* a starting point for their journey
* a scale map of the world, showing different time zones and the flight paths or path of travel chosen
* coordinates of treasure locations in latitude and longitude
* the local times of arrival at and departure from each of the locations. Time must be allowed for rest and sleep breaks.

### Students working towards Level 5

Apprentice treasure hunters are in training and have a mission to gather seven treasures from around Australia. As their travel agent, you must provide them with an itinerary to collect the items in five days and nights.

The apprentice treasure hunters will need:

* a starting point for their journey — the journey must end in Brisbane
* a scale map of Australia showing different time zones and travel paths
* treasure locations in latitude and longitude.

## 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 |
| Setting the scene  Students:  discuss the investigation and identify what they know and what they need to know and find out to present an itinerary for the culminating task.  Working with time zones, coordinates and scale  Students:  research national and international time zones  investigate Greenwich Mean Time (GMT), Universal Time Coordinates (UTC), and time zones within Australia  investigate longitude, coordinates and the correlation between lines of longitude and time  investigate how scale is used on maps.  Working with timetables and travel itineraries  Students:  list the features of timetables and answer questions posed in relation to a simple travel itinerary. |  | Converting time across time zones  Students:  develop real-life scenarios related to converting time across time zones.  Co-developing an itinerary  Students:  work in pairs to develop an itinerary for the apprentice treasure hunters to go on a short treasure hunt.  Talking about the learning  Students:  discuss the itinerary they developed in the previous activity. They use peer feedback on their itinerary to enhance their response to the culminating task in the next phase. |  | Culminating task  Students:  independently complete an itinerary for a group of international treasure hunters or apprentice treasure hunters to collect seven treasures from around the world or from around Australia  present and explain their itineraries and justify decisions made. |

## Core learning outcomes

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

**M 5.2** Students interpret and solve realistic problems related to time management and time zones within Australia.

**M 6.2** Students analyse and use a variety of timetables to justify time management decisions, and interpret and solve realistic problems involving international time zones.

**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.

**S 6.2** Students interpret maps and plans using standard conventions, provide directions based on bearings and distance, and use longitude to explain time differences between major locations.

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 learn where and when to apply their knowledge of Greenwich Mean Time, Universal Time Coordinates and time zones within Australia, and investigate the relationship between time zones and longitude. |
| **Complex thinker** | Students demonstrate deductive thinking and reasoning as they investigate and solve complex problems associated with the development of national and international travel itineraries. |
| **Responsive creator** | Students think, reason and work mathematically when they are given parameters in which a proposed itinerary must begin and end. |
| **Effective communicator** | Students select appropriate mathematical language to convey, logically and clearly, their understandings about why choices about travel, rest and sleep were made in their final itinerary for the treasure hunters or the apprentice treasure hunters. |
| **Reflective and  self-directed learner** | Students draw on what they know to investigate possible travel itineraries — they plan, manage and evaluate their ideas and knowledge. |

Core content

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

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| Measurement — Time: Level 5 | Space — Location, direction and movement: Level 5 |
| Units and conventions   * Australian time zones * Eastern Standard Time (EST) * Central Standard Time (CST) * Western Standard Time (WST) * daylight saving time * timetables   Relationships   * decimal representations of time units  (e.g. 2.25 hours = 2 hours 15 minutes) * duration * time calculations * timetables of more than one week duration | 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 |
| Measurement — Time: Level 6 | Space — Location, direction and movement: Level 6 |
| Units and conventions   * international time zones * Greenwich Mean Time (GMT) or Universal Time Coordinates (UTC) * International Date Line * timetables   Relationships   * time zones and longitude * synchronisation of events * duration * time calculations | Location and movement   * conventions * scale on maps expressed as ratio (e.g. 1:25; 1:40) * coordinates * fractions of degrees expressed as minutes (mentally and on scientific calculators) * latitude and longitude expressed in degrees and minutes * scale on floor plans expressed in millimetres * key referents for international time zones * Greenwich Mean Time (GMT) or Universal Time Coordinates (UTC) * International Date Line * link between longitude and time * distance and bearing   Direction and angle   * maps (local environment) with a given scale * navigational instructions based on distance and bearings (using protractors) |

## Resources

* timetables for travel between Australian capital cities — plane, bus and train
* timetables for international travel
* atlases containing maps of the world and featuring lines of longitude and the International Date Line
* globes
* useful websites and books that contain information about Greenwich Mean Time, Universal Time Coordinates and Australian time zones
* stimulus pictures relating to treasures listed in the culminating task. For example, a photograph of a Masai necklace, Ned Kelly’s armour or other items listed in this investigation or suggested by students
* telephones for roleplays
* cardboard for making scenario cards or laminated computer printouts

Identifying and describing

### Setting the scene for the investigation

Students:

* identify and list what they already know about time zones
* identify whether they are working towards demonstrations of M 5.2 and S 5.2 (Australian context) or M 6.2 or S 6.2 (international context)
* discuss the suggested list of treasures outlined in the ‘Communicating and justifying’ phase of this investigation (below). They may adapt this list by making suggestions about other treasures or destinations according to criteria such as visiting each continent
* establish where each of the treasures is located on an existing world or Australian map and record their map locations, coordinates or grid references
* discuss possible starting points and times for travel
* discuss how the starting point and order of visits to each of the locations may affect the time taken for the entire journey
* discuss the use of timetables, duration of travel, time zones, distances to travel, connecting flight/s, buses.

Focus questions could include:

What are the seven treasures and where can they be found? Focus on map location, grid references and coordinates.

Which modes of travel would best meet the needs of the investigation?

What issues do you think are important when considering the order of collection/visit to each location?

What are the possible travel arrangements?

If the treasure hunters or the apprentice treasure hunters need to make telephone calls to keep in touch with ‘home base’, what effect will this have on the itinerary? Students discuss possible allocation of time for phone calls.

### Working with time zones, coordinates and scale on maps

Students:

* gather resources that could assist them when calculating time differences and looking up international and national time zones
* research information on international time zones and, in pairs, share main points from their research with others. Students working towards Level 6 focus on finding out about GMT and UTC
* discuss the reason for having GMT and UTC and the relationship between longitude and time
* examine lines of longitude and coordinates on a globe, world map or map of Australia
* investigate how coordinates are used to locate cities, towns or places of significance. Find out about how to use conventions such as degrees and minutes
* investigate how scale is used on an Australian map or world maps. Students may make calculations regarding actual distance
* use the starting point chosen earlier as a reference point to investigate the different time zones around the world.

**Students working towards Level 5** investigate the features of Australian time zones (Eastern Standard Time, Central Standard Time, Western Standard Time and daylight saving time).

### Working with timetables and travel itineraries

Students:

* examine a variety of national and international travel timetables and list the features they have in common
* use the timetables to answer questions posed in relation to a simple international or national travel itinerary
* access travel websites and other information to answer these questions where necessary.

Focus questions could include:

You arrive in London at 6:00 p.m. local time. You need to collect the Magna Carta and leave London to arrive in Los Angeles to collect ET’s spaceship by midday the next day. Is this possible? What type of transportwill you need to take*?*

You need to travel from Broome to Weipa. What is the fastest route and how long will it take?

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| Assessing learning |
| Sources of evidence could include:   * observation notes of discussions * responses to questions posed in relation to Australian time zones and international time zones * map locations, grid references or coordinates of the seven treasures.   When making judgments, teachers consider whether the student has:   * interpreted realistic problems related to time zones within Australia * analysed and used a variety of timetables * interpreted maps and plans referring to latitude and longitude * interpreted maps and plans using standard conventions * used longitude to explain time differences between major locations. |

## Understanding and applying

### Converting time across time zones

Students:

* develop problems or questions where the treasure hunters have to determine whether it is the ‘right time’ to ring home base.
* Example of a student’s question:

‘You are in Buenos Aires, home base in Australia requires your phone call between 9:00 a.m. and 12 midday (EST). If you make the call at 10:00 a.m., will your call meet the time parameters?’

* develop scenarios that involve contact being established between treasure hunters on different continents
* write problems, questions and scenarios on cards and place these in a common ‘pool’ for others to select from
* select a card and use the information they have on time zones to solve the problem, answer the question or resolve the issue posed by the scenario. Points could be awarded for accurate or inventive resolutions.

**Students working towards Level 5** play a version of a problem-solving game that involves developing problems, questions and scenarios that involve time zones within Australia.

### Co-developing an itinerary — practising for the culminating task

**Students working towards Level 6** form pairs and:

* use the knowledge, processes and strategies from previous activities in the following scenario:

‘You are the travel agent for the apprentice treasure hunters and you are responsible for organising their itinerary for a rushed world treasure collection. The apprentice treasure hunters have to collect two world treasures in four days, on two different continents. They must begin their search each day at 9:00 a.m. local time.’

* plan and present a proposed itinerary for the apprentice treasure hunters to classmates. Included in the proposal should be a scale map of the world that shows the different time zones and flight paths of any selected flights, and the corresponding coordinates in longitude and latitude of the cities visited. Peers will be asked to comment on the feasibility of the itinerary. Students will need to access resources that show time zones, transport times (flights, trains) and accommodation costs. There are no budget restrictions in this investigation.

Focus questions could include:

How does your itinerary look after the physical health of the apprentice treasure hunters?

Have you been able to include time for rest and recreation?

**Students working towards Level 5** imagine that the apprentice treasure hunters are gathering three treasures from different places in Australia. They have one day to collect the treasures. The itinerary for the apprentice treasure hunters should include timetable information for flights, train trips and bus trips.

**Note:** Participation in these scenarios is intended to provide students with opportunities to apply what they have learned about Time and Space during the previous activities. By working in pairs, students can take advantage of peer discussion and feedback to enhance their **independent** development of the itinerary for the culminating task in the final phase of this investigation.

### Talking about the learning

Students:

* reflect on feedback given by classmates about their itinerary. The teacher and students revise and make explicit the mathematical knowledge, processes and strategies needed to develop the itineraries for the culminating task.

Focus questions could include:

How will what we have learned help us in the culminating task?

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| Assessing learning |
| Sources of evidence could include:   * observations made during problem-solving activities * responses to independent problem-solving activities * students’ feedback to others’ itineraries.   When making judgments, teachers consider whether the student has:   * identified and interpreted realistic problems involving international time zones * interpreted and solved realistic problems related to time management and time zones within Australia * used longitude to explain time differences between major locations * interpreted maps and globes referring to latitude and longitude * interpreted maps and plans using standard conventions. |

Communicating and justifying

### Culminating task

**Students working towards Level 6** complete the following tasks independently:

* develop a travel itinerary for international treasure hunters who have approached their travel agency and asked the agency to help plan their journey around the world to gather seven treasures in 21 days
* design the itinerary to ensure that the treasure hunters visit each of the destinations where the treasures are located. The treasure hunters will need:

a starting point for their journey

a scale map of the world, showing different time zones and the flight paths or path of travel chosen

latitude and longitude of the treasure locations

the local times of arrival at and departure from each of the locations (allow time for rest and sleep breaks).

A suggested list of world treasures is outlined below (this could be adapted or changed based on suggestions from the students):

an ancient gold Incan mask from Machu Picchu, Peru

Ned Kelly’s armour, Melbourne, Australia

the Magna Carta from the British Library, London, UK

ET’s spaceship from Universal Studios, Los Angeles, USA

Michelangelo’s diary from the Vatican, Rome, Italy

a Masai necklace from a Masai tribe, Kenya, Africa

Genghis Khan’s sword, Beijing, China

* research and present the itinerary and explain the procedures and strategies they used to formulate it
* justify the forms of transport chosen, and the time and order of treasure collection and visits.

**Students working towards Level 5** complete the following task independently:

* provide the apprentice treasure hunters with an itinerary to collect the items listed below from around Australia in five days and nights (students may also suggest their own list of items based on criteria developed by the group):

a pearl from Broome, Western Australia

a crocodile souvenir from Kakadu National Park, Northern Territory

a piece of bauxite from Weipa, Queensland

a merino fleece from Dubbo, New South Wales

an opal from Coober Pedy, South Australia

an item of designer clothing from Melbourne, Victoria

a photograph of Cradle Mountain, Tasmania

The apprentice treasure hunters will need:

a starting point for their journey — the journey must end in Brisbane

a scale map of Australia showing different time zones and travel paths

treasure locations in longitude and latitude

The apprentice treasure hunters must use three different forms of transport — excluding private vehicle — to complete the treasure collection. The apprentice treasure hunters must finish their journey in Brisbane. They must also telephone their boss in Brisbane daily at 6:00 p.m. local time. If the apprentice treasure hunters are to make the call from a time zone that differs from Queensland’s, the time for the phone call needs to be listed in the itinerary in local time. The challenge is to complete the treasure hunt within five days while allowing some rest for the hunters each night.

* research and present the itinerary and explain the procedures and strategies they used to formulate it
* justify the forms of transport chosen, and the time and order of treasure collection and visits.

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| Assessing learning |
| Sources of evidence could include:   * presentations of itineraries, and reasoning and justification provided by students.   When making judgments, teachers consider whether the student has:   * interpreted and solved realistic problems related to time management and time zones within Australia * analysed and used a variety of timetables * justified time-management decisions * interpreted and solved realistic problems involving international time zones * interpreted maps and globes referring to latitude and longitude * used longitude to explain time differences between major locations. |

Links

This investigation could be connected to core learning outcomes from another key learning area — for example, the Arts.

### Mathematics

**Strand** Media

Students design and make a video to illustrate a fictional journey to one of the destinations in this investigation. The video would premiere at a ‘film night’ for potential sponsors to gain their financial support for future treasure hunters to travel around the world.

**ME 5.1** Students construct and reconstruct meaning through the application of languages and technologies in the design and production of media texts.

Students:

* produce a set, design, script and storyboard for their presentation about one of the locations visited on the treasure or scavenger hunt. They examine transitions between scenes and the technologies needed. Students shoot the video, edit it and add music.

**ME 5.2** Students emulate industry practices to promote, deliver and exhibit media texts in a range of contexts.

Students:

* plan for the film night. They formulate a list of invitees for the film night after investigating appropriate industry sources to invite.

**ME 5.3a** Students research and analyse various media representations within their cultural and historical contexts.

Students:

* examine and analyse documentaries and travel programs to assist their understanding of ways to represent travel on film. This analysis will assist the formation of a storyboard.

**ME 5.3b** Students research and examine the media institutions that are involved in the production, distribution and exhibition of the media they consume as audiences.

Students:

* visit a production house to gather information about the distribution and exhibition of different types of media. They examine the rationale behind non-commercial travel shows and commercial travel shows. They use this information to form a rationale for their own video product.

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

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David Lang and Morris Oates of Wynnum State High School developed this investigation collaboratively with the Queensland Studies Authority.