Geography
Unit 3BGEO
Geography of climate change over geological time

Learning context: Urban settlement and industry

This unit package contains
- a teaching program
- an assessment outline
- assessment tasks
Program: Geography Unit 3B GEO

Unit 3B GEO: The geography of climate change over geological time

Unit overview
The 3B GEO investigates policies and strategies designed to guide future action used to address the effects of the climate change. Key themes explored during this one semester program are:

1. Introduction to Climate Change
2. The Earth as a System
3. Climatic Change Factors (What is it that causes changes in climate?)
4. Evidence for Climate Change (What Proof do we have that climate change exists?)
5. The Human Touch on Climate Change
6. The Impact of Climate Change on Spatial Patterns within the Natural Environment
7. The Impact of Climate Change upon Spatial Patterns of Human Settlements
8. The Impact of Climate Change on Urban Settlements and Industry
9. Values and Viewpoints in People’s Use of Places
10. Climate Change—Planning for a Bright Forecast

Unit outline
Climate change possesses the capacity to affect significant areas of the planet. Climate change, including the greenhouse effect, is created by both natural and human processes that have local and global consequences. The human response to climate change is affected by social, economic and political considerations, and resource access and distribution.

With this focus in mind, the unit will examine the geography of climate change over geological time through:

- geographical knowledge and understandings
- the use of a variety of resources (e.g. maps, articles, books, websites, tables, statistics etc.)
- the application geographical thinking and questioning
- geographical inquiry based research projects
- mapping and practical skills

Why study Unit 3B GEO?
Since the onset of the Industrial Revolution, the climate of the planet has changed tremendously, and even more-so over the last few decades, primarily due to pollution, increased greenhouse gas emissions and depletion of the ozone layer. Global warming is one of the main factors of climate change, leading to excessive flooding, forest fires and rise in global temperatures to name a few.

While the prognosis for a bright climatic future may seem somewhat bleak, scientists have analysed climate change and identified some main features that work like early warning signs such as heat waves, periods of unusually warm weather, sea level rising, coastal flooding, ocean warming, and melting of glaciers. Such advancements in technology are not only paving the way for further research, but providing valuable data and information to educate societies on how to minimise the effects of our actions now and how to better prepare for any future climatic extremes.

By studying climate change, students will be equipped with:

- a comprehensive understanding of the causes of changes in climate
- information on how to prepare for possible natural hazards and/or predicted extreme changes
- detail to help identify both man-made and natural causes for climate change
- an understanding on how climate change has and will an impact on human health and the environment
- useful strategies in managing climate change.
# Unit 3B GEO

## Geography of climate change over geological time: Urban settlement and industry

### Teaching and learning program

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- **Note to teachers:**
  - **Del.icio.us** (pronounced ‘delicious’)
    This is a [social bookmarking web service](http://en.wikipedia.org/wiki/Del.icio.us) for storing, sharing, and discovering [web bookmarks](http://del.icio.us). The site was founded by [Joshua Schachter](http://en.wikipedia.org/wiki/Del.icio.us) in late [2003](http://del.icio.us), and was acquired by [Yahoo!](http://del.icio.us) in [2005](http://del.icio.us).

### A site has already been set up for this unit. For online resources, please go to [http://del.icio.us/tag/3BGE](http://del.icio.us/tag/3BGE)

If you have a del.ico.us account, tagging sites related to this unit with ‘3BGE’ will make them available for all Geography teachers and students.

### Lesson #1

#### Course introduction

**Unit 3BGE**  
Climate change

**Selected Unit Context:**  
*Urban Settlement and Industry planning for sustainable living energy consumption and water supply*

This context was selected as the Semester One unit on Planning Cities would have already covered many important issues on sustainability in cities.

**Focus:** The focus for this unit will be on **climate change**. Understanding the mechanisms of climate change will be developed at a global scale. The selected ‘context’ comes into play ONLY in the Human Influence on Sustainability section.

#### Welcome

Introduce the new unit and discuss what it entails and outline the context/focus for study.  
Tip: at this point you may wish to show an engaging PowerPoint presentation introducing the unit and scope of context for study.

Distribute course and assessment outlines.  
Cover class expectations if necessary.

Introduce Del.icio.us as a class resource.  
Cover the range of resources (texts etc.) available to students.

[Pre-unit quiz](http://del.icio.us/tag/3BGE) (to ascertain exactly how much students already know about climate change, the greenhouse effect and other related concepts etc.)

#### Informal:

- Pre-unit quiz

  Semester Program – Std version  
  Assessment Outline – review
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</table>
| 1-2  | Introductory unit content  
The concepts of climate change and the greenhouse effect. | ![Image](#) **Introduction to climate change**  
- Website investigation and/or resource study: students to examine definitions of climate change, global warming and the greenhouse effect; look at what students already know (from pre-unit quiz results) and start to establish some very clear points of reference from which to build further understanding.  
- Use a diagram/illustration to explain the greenhouse effect.  
- Describe the types of radiation that are involved and the wavelength of the radiation.  
- Use a diagram/illustration to explain the composition of the Earth’s atmosphere (gases and layers).  
- Use GIS images/resources to find the infamous ‘hole’ in the ozone layer. Approximately how big is it, where is it, and why is it there?  
- Capture a series of images from GIS (or maps/diagrams from texts) illustrating the hole and discuss whether it is currently getting larger or smaller?  
- Select a variety of cartoons on the ‘greenhouse effect’ to evoke discussion and interests amongst students. Have them critically analyse the cartoons and explain what the ‘real message’ is in each.  
- Construct a ‘climate change’ glossary for key terms and concepts learnt in this unit (this will be ongoing throughout the duration of the unit).  

**FOCUS QUESTIONS:**  
a) What is climate change?  
b) What is global warming?  
c) What is the greenhouse effect?  
d) What is the enhanced greenhouse effect?  
e) List the major greenhouse gases and their natural and anthropogenic sources.  
f) Which gases are enhancing the greenhouse effect the most?  
g) List and briefly describe the different forms of water vapour in the atmosphere.  
h) How does ozone differ from oxygen? Where is ozone found?  
i) Why is it important to humans?  
j) How do the troposphere and stratosphere differ?  
k) What is ‘ozone depletion’ and how does it occur?  

- Websites:  
  Use Internet search engines to find sites relating to climate change such as:  
  - [http://www.cartoonstock.com/newscartoons/directory/g/greenhouse_effect.asp](http://www.cartoonstock.com/newscartoons/directory/g/greenhouse_effect.asp)  
  - [http://www.research.noaa.gov/k12/pdfs/gresall.pdf](http://www.research.noaa.gov/k12/pdfs/gresall.pdf)  
  
  Note: As you find good websites, ensure you save them to the Del.icio.us site.  

Task 1: Natural Climate Systems (in-class test) |
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| 2–4  | Variations in the spatial patterns linked with the heat budget, hydrological cycle, carbon cycle and atmospheric circulation. | **The Earth as a System**  
- Have students look at the Earth’s climate as a ‘system’. Briefly discuss (inc. diagrams) key elements of the following natural systems that drive the Earth’s climates:  
  - Heat budget  
  - Hydrological cycle  
  - Carbon cycle  
  - Atmospheric circulation  
  *Note: these don’t need to be looked at in immense detail, but just enough to give students the ‘big-picture’ idea of the Earth’s climates.*  
- Describe the key processes that drive each system.  
- Outline how introduced changes can impact on each system (cultural and natural).  
- Use an illustration/sketch to explain the general global pattern of atmospheric circulation (largely revision from 2AGEO).  
- Students are to use maps/GIS to look at the Earth’s climatic zones (Koeppehen’s classification) and explore and describe the spatial associations between climate zones and natural systems.  
- Explain the ways are/can the aforementioned natural systems be disrupted by climate change?  
- Students to use evidence (statistics, maps/GIS etc.) to account for variations in the spatial patterns linked with the heat budget, hydrological cycle, carbon cycle and atmospheric circulation (e.g. with relation to the H2O cycle, spatial variations exist between water over land and sea).  
**FOCUS QUESTIONS:**  
a) Differentiate between weather and climate.  
b) What is the basis for Koeppehen’s classification? How was it developed?  
c) How do aerosols influence climate? Where do they come from? |  
Books:  
Books:  
Books:  
 Websites:  
http://en.wikipedia.org/wiki/Climate_change |
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<tr>
<td>5–6</td>
<td>PaC Spatial association</td>
<td>Climatic cycles and variations in spatial patterns associated with natural processes e.g. solar output, orbit variations, geological patterns and processes, volcanoes, atmospheric gases and chemistry, El Nino/La Nina effects, Pacific decadal cycle, North Atlantic variations, polar ice variations.</td>
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<td>- Climate changes reflect variations within the Earth’s atmosphere, processes in other parts of the Earth such as oceans and ice caps, and the effects of human activity. The external factors that can shape climate are often called ‘climate forcings’ and include such processes as variations in:</td>
<td>Keller E. &amp; Blodgett. R. (2008). <em>Natural Hazards: Earth’s Processes as Hazards, Disasters and Catastrophes 2nd Edition</em>. Pearson Prentice Hall’ New Jersey (pp. 350–381).</td>
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<td>- Ocean variability</td>
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<td>- The memory of climate (hysteresis)</td>
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<td>- Non-climate factors driving climate change:</td>
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<td>- Greenhouse gases</td>
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<td>- Plate tectonics</td>
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<td>- Solar variation</td>
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<td>- Orbital variations (Milankovitch effect)</td>
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<td>- Volcanism</td>
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<td>- Human influence on climate change (anthropogenic):</td>
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<td>- Fossil fuels</td>
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<td>- Aerosols</td>
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<td>- Cement manufacture</td>
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<td>- Land use</td>
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<td>- Livestock</td>
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<td>Students are to research and explain each of the aforementioned ‘forcings’ that contribute to climate change. Relevant ‘case study’ examples are to be employed wherever possible.</td>
<td>Websites: [<a href="http://www.ace.mmu.ac.uk/eaec/Climat()%7D">http://www.ace.mmu.ac.uk/eaec/Climat()}</a></td>
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<td>Select one or two ‘forcings’ from each of the three sections:</td>
<td><a href="http://www.ace.mmu.ac.uk/eaec/Climat">Climate_Change/Older/Climate_Forcing.html</a>}</td>
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<td>With the aid of an annotated diagram, discuss how each is thought to influence climate cycles.</td>
<td><a href="http://en.wikipedia.org/wiki/Milankovitch_cycles">http://en.wikipedia.org/wiki/Milankovitch_cycles</a></td>
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<td>View online animations of these ‘forcings’ over time (e.g. those available on NASA sites).</td>
<td><a href="http://www.ncdc.noaa.gov/paleo/milankovitch.html">http://www.ncdc.noaa.gov/paleo/milankovitch.html</a></td>
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<td>On a map, locate where/show how the ‘forcings’ are associated with specific climatic patterns—is there any relationship? Explain.</td>
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<td>Account for climatic cycles and variations in spatial patterns.</td>
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<td>Briefly touch on the evidence to support the influence of each ‘forcing’ on climatic cycles—this will be discussed in greater depth in the next module.</td>
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<td>Week</td>
<td>Syllabus outline</td>
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| 7–8  | PaC Location and spatial distribution  
Evidence for climate change through geological time, as well as in recent human history e.g. palaeoclimatology, atmospheric circulation changes, sea level changes, enhanced greenhouse effect and frequency of extreme weather events.  
Geographical thinking, skills and processes (GTSaP)  
- Types of questions  
- The use of technology (GIS)  
- Geographical language when discussing climate change |  
- FOCUS QUESTIONS:  
a) Explain solar, volcanic and anthropogenic forcing.  
b) Explain the concept of a climatic cycle.  
Evidence for climate change (What proof do we have that climate change does exist?)  
- Evidence for climate change:  
  - Paleoclimatic changes  
  - Tree rings  
  - Glacial geology (ice cores)  
  - The decline of winter (retreating glaciers)  
  - Shifts in the natural world (biogeography)  
  - Extreme weather events (frequency)  
  - Sea-level changes (evidence in coastlines, estuaries, low-lying land etc.)  
  - Enhanced greenhouse effect (rise in anthropogenics)  
  - Pollen analysis.  
- Outline and discuss the evidence for climate change through geological time (Phanerozoic—last 500 to today), as well as in recent human history (Anthropocene): students to construct a timeline to plot and discuss significant points in time illustrating evidence for climate change.  
- Construct a cross-classification chart to compare and contrast climate change (Phanerozoic—Anthropocene). Use column headings such as ‘amount of change’, ‘rate of change’, ‘impact on natural environment’ – you may wish to add others.  
- Use charts and diagrams from the Intergovernmental Panel on Climate Change (IPCC) and describe the evidence for climate change depicted in each chart and assess the validity of evidence presented in each chart.  
- Students to view the documentary: An Inconvenient Truth by Al Gore. Use the following link to download copies of the ‘study guide’.  
Each student to have own copy of the ‘study guide’ and to work through activities and questions (you may choose to do all or some, depending upon your class). |  
Books:  
Websites:  
http://www.ace.mmu.ac.uk/eae/Cli mate_Change/Older/Evidence.html  
http://unfccc.int/essential_backgro und/feeling_the_heat/items/2904tx.php  
http://www.bbc.co.uk/climate/evid ence/  
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<td>EXTENSION ACTIVITY:</td>
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<td> If the class is particularly able and moving through course material quickly:</td>
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<td>• Brief discussion on ‘bias’ in sources/resources. Make a note to students that while studying this unit, to be mindful of potential bias in sources and to always ask questions.</td>
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<td>• Show parts of/entire documentary: The Great Global Warming Swindle.</td>
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<td>• Have a class discussion on the film, using geographical knowledge from the course thus far to either support or debunk main arguments presented. Compare this with the An Inconvenient Truth documentary.</td>
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<td> FOCUS QUESTIONS:</td>
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<td></td>
<td>a) Describe the natural hazards (e.g. volcanoes etc.) associated with climate change.</td>
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<td>b) How is climate change likely to affect the weather?</td>
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<td>c) Which processes are contributing the most to rising sea level?</td>
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<td>d) How will climate change affect the biosphere?</td>
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<td>e) How are desertification and drought related to climate change?</td>
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<td>f) Which parts of our planet are experiencing the greatest effects of climate change?</td>
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<td></td>
<td>g) What parts of the globe are experiencing the greatest effects of climate change?</td>
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<td>h) Is climate change a bad thing for everyone? Why/why not?</td>
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<td>i) What are the projected changes to our climate for the remainder of this century?</td>
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Programs:
### Syllabus outline

**PaC**

**Spatial association**
Cultural patterns and processes and their interaction with natural systems affect climate change i.e. agricultural land use, urban land use, including power generation, transport, industry, pollutants and aerosols, human sources of greenhouse gases.

**Geographical thinking, skills and processes (GTSaP)**

**Geographical thinking and questioning**
- Research tasks using general and specific research questions
- Information obtained from a variety of maps etc.
- Geographical language
- Data for bias, viewpoint values, importance and reliability and draw inferences from this
- Focus questions.

#### The human touch on climate change

- Students to explain how human interaction/s with natural systems (e.g. heat budget, hydrological cycle) affects (+ve and −ve) climate change.
- Students are to use a range of resources to construct a cross-classification chart (see below for example):

<table>
<thead>
<tr>
<th>Cultural Patterns and Processes</th>
<th>Interaction with Natural Systems</th>
<th>Contribution to Climate change</th>
<th>Time Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural land use</td>
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<td>Urban land use</td>
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<td>Power generation</td>
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<td>Transport</td>
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<td>Industry</td>
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<tr>
<td>Pollutants and aerosols</td>
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<tr>
<td>Anthropogenic sources of greenhouse gases</td>
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</table>

- Students to investigate if human interactions with natural systems are likely to affect climate change more in MDCs than LDCs (use statistics to support discussion).
- Find the world’s biggest (e.g. USA) and smallest (e.g. Oceania) contributors of anthropogenic emissions to global warming. Make comparisons between the natural systems in each: which has impacted more on climate change and how?
- Explain the effect this has on climate change?
- Identify which countries from these contributors are considered MDCs and LDCs? Is there any correlation between a countries wealth and its degree of anthropogenic emissions?
- How do these countries rate to those countries which are considered to be moderate contributors e.g. East Asia?
- Use GIS images to identify and discuss spatial associations between the location of the world’s biggest contributors of anthropogenic emissions and the positioning of fossil fuel extraction sites, heavy industry sites, megacities and dense population. What are the correlations?
- Discuss how the natural systems in these locations compare to those in other parts of the world (enhanced greenhouse effect). Students to ensure they support their discussions with relevant statistics, GIS data, maps etc.

### websites:


### Assessments

**Task 2:** Is Perth’s climate changing? (Begin Geographical inquiry)
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| 10   | PaC Spatial interaction | The impact of climate change on spatial patterns within the natural environment  
- Students to describe how climate change affects spatial patterns in the natural and cultural environments e.g. if temperatures in the SW of WA become hotter by just a couple of degrees, there will be a change in the range of native vegetation/biodiversity; the Proteaceae family will disappear.  
ACTIVITY:  
- Students (in small groups) to undertake a case-study on the impact of climate change in a selected natural environment (e.g. tropical rainforests, coral reefs, wetlands, islands – Torres Strait Islands etc.). This examination will need to include:  
  a) A series of maps and/or GIS images to illustrate how the distribution of the selected environment has, and is expected to, change due to climatic change.  
  b) A description of the impact of climate change on the selected environment (inc. supporting statistical data etc.)  
  c) An explanation of how these changes may impact on other systems within the environment.  
- Students may ‘jigsaw’ their case-study investigation with the rest of the class.  
Food for Thought: This particular point may lend itself to ‘fieldwork’ as students can easily visit a local ecosystem (e.g. wetland, reserve, beach) and report on the biodiversity, making inferences to change over time. Local governments, agencies and volunteer groups may be able to supply some reliable data and/or observations. | Websites:  
| 10   | PaC Spatial interaction | The impact of climate change upon spatial patterns of human settlements  
- Students to hypothesise and/or discuss ways in which climate change will impact on human settlement:  
  Select one city (e.g. Perth or San Francisco) and one island nation (e.g. The Maldives) and for each:  
  - use a series of maps and/or GIS images to show how sea level rises of 1m, 2m and 5m would affect human settlement (hazard risk analysis) | Websites:  
http://www.greenpeace.org/international/campaigns/climate-change/impacts/sea_level_rise  
http://www.warwickhughes.com/climate/maldives.htm  
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| 11–12 | Human influence on sustainability (HIoS)  
Factors that impact on decisions about sustainability  
- The concept of sustainability  
- The extent to which climate change impacts upon sustainability from local to global levels.  
Geographical thinking, skills and processes (GTSaP)  
Geographical thinking and questioning  
- Research tasks using general and specific research questions  
- Information obtained from a variety of maps etc.  
- Geographical language  
- Data for bias, viewpoint values, importance and reliability and draw inferences from this  
- Focus questions | outline and discuss the impacts (short, medium and long-term) of these sea level rises on the selected settlements.  
- What evidence exists today to illustrate that such human settlements are already under threat of climate change, and more specifically sea level rising?  
- In what ways have people adapted to the changes? *this will be discussed at greater depth in a later module.  
- Students to discuss how climate change will affect Australia’s cultural heritage and Australia’s indigenous communities.  

FOCUS QUESTIONS:  
[http://users.rcn.com/jtitus/Maldives/Small_Island_States_3.html](http://users.rcn.com/jtitus/Maldives/Small_Island_States_3.html)  
[http://users.rcn.com/jtitus/11–12](http://users.rcn.com/jtitus/11–12) |  |
| | The impact of climate change on urban settlements and industry  
- Website investigation and/or resource study: students to examine definitions of sustainability; look at what students already know (from class discussions) and start to establish some very clear points of reference from which to build further understanding.  
- For Urban Settlement and Industry:  
  - Energy consumption and water supply.  
- Local level:  
  - Explain how decisions about sustainability apply to energy consumption and water supply in Perth.  
- Regional level:  
  - Explain how decisions about sustainability apply to energy consumption and water supply in Australia.  
- Global level:  
  - Explain how decisions about sustainability apply to energy consumption and water supply on Earth.  
- Discuss the specific ways in which climate change has impacted on sustainability of energy consumption and water supply at each of the three scales? (If possible, include reference to short, medium and long-term ways so as to give an idea of scope). | [http://en.wikipedia.org/wiki/Energy_consumption](http://en.wikipedia.org/wiki/Energy_consumption)  
The key environmental, economic, social and political factors that impact upon decisions about sustainability.

FOCUS QUESTIONS:

a) Explain the principles of sustainability with relation to energy consumption and water supply?

b) What measures are being employed throughout the world to apply principles of sustainability to energy consumption and water supply? Is this consistent throughout the world (LDCs and MDCs)?

- Discuss the key environmental, economic, political and social factors that impact upon decisions about sustainability in terms of ‘Energy consumption and water supply’.
  Note: Students may wish to organise thoughts into a cross-classification chart prior to writing. See example:

<table>
<thead>
<tr>
<th>Energy Consumption and Water Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental</td>
</tr>
<tr>
<td>Decisions about Sustainability</td>
</tr>
</tbody>
</table>

- Students may wish to undertake a discussion of the key environmental, economic, political and social factors that impact upon decisions about sustainability in terms of ‘Energy consumption and water supply’ at a local (Perth) and/or regional (Australia) level.

FOCUS QUESTIONS:

a) What is energy consumption?

b) What is water supply?

c) With respect to energy consumption, what types of energy resources are used in Australia and how do they contribute to climate change?

d) From where does Australia get its main water supplies?
<table>
<thead>
<tr>
<th>Week</th>
<th>Syllabus outline</th>
<th>Suggested teaching skills and strategies</th>
<th>Resources</th>
<th>Assessments</th>
</tr>
</thead>
</table>
| 13   | **(HloS)** Values and viewpoints in people's use of places  
The different values and viewpoints which stakeholders have towards strategies that aim to minimise the effects of climate change e.g. wealthy nations, developing/emerging nations, state and regional governments, environmental groups, multinational corporations, non-government organisations. | **Values and viewpoints in people's use of places**  
- Identify the key stakeholders specifically involved with energy consumption and water supply in Australia.  
- Students to outline and describe the different values and viewpoints of these stakeholders in relation to energy consumption and water supply in Australia.  
- Identify and explain the values and viewpoints these stakeholders have towards strategies that aim to minimise the effects of climate change (PMI Chart to establish and arrange thoughts for later discussion and explanation).  
- Students to identify the same group of stakeholders around the world (e.g. all wealthy business owners in Australia, USA, Finland, Tokyo, Egypt, Thailand etc.) and compare and contrast their values and viewpoints on the same strategies that aim to minimise climate change:  
  - Are their views the same? Why/why not?  
  - Is there any correlation between the same stakeholder groups and their place of residency: LDCs and MDCs?  

**FOCUS QUESTIONS:**  
a) Do all stakeholders perceive climate change to be a negative thing? Why/why not? | ☢ Websites:  
http://en.wikipedia.org/wiki/Water_supply  
http://ideas.repec.org/p/rsm/murrar/m06_3.html  
http://www.viacorp.com/perth_water.htm  
http://www.sustainableseq.org.au/cat_questions/climate_questions/climate_questions.shtml#clim_quest_four | Task 5: Human Responses to climate change (in-class Extended Answer) |
| 14   | **(HloS)** Care of places  
- The current and proposed strategies implemented to reduce the adverse effects of climate change.  
- How human activity has adapted or may be required to adapt to climate change. | **10. Climate change—Planning for a bright forecast**  
- For each of the following points, make reference to local, regional and global scales and over time (short, medium and long-term):  
  - Discuss and explain the current strategies implemented to reduce the adverse effects of climate change.  
  - Discuss and explain the proposed strategies implemented to reduce the adverse effects of climate change.  
  - Discuss how human activity (lifestyle, work, settlement, transport etc.) has adapted to climate change.  
  - Discuss how human activity may be required to adapt to climate change.  
  - Students to identify and assess the effectiveness of strategies through a PMI Chart. Students to include strategies at local, regional and global scales.  
  - Class discussion based on findings from the PMI Chart. | ☢ Websites:  
http://en.wikipedia.org/wiki/Carbon_dioxide_sink  
http://en.wikipedia.org/wiki/Kyoto_protocol | |
<table>
<thead>
<tr>
<th>Week</th>
<th>Syllabus outline</th>
<th>Suggested teaching skills and strategies</th>
<th>Resources</th>
<th>Assessments</th>
</tr>
</thead>
</table>
| 15   | Geographical thinking, skills and processes (GTSaP)  
Geographical thinking and questioning  
- Research tasks using general and specific research questions  
- Information obtained from a variety of maps etc.  
- Geographical language  
- Data for bias, viewpoint values, importance and reliability and draw inferences from this  
- Focus questions  
  FOCUS QUESTIONS:  
  a) How have international agreements dealt with ozone depletion and climate change?  
  b) What is the Kyoto Protocol?  
  c) When did Australia ratify the agreement? Why did it take so long and what does this mean for Australia?  
  d) Which countries are and are not ratified and why?  
  e) What are the proposed methods for carbon sequestration?  
  Which method holds the greatest promise and why?  
  f) What is carbon offsetting and emissions trading? | Task 6: Semester Examination |
## Assessment outline for Unit 3BGE0
**Geography of climate change over geological time—Urban settlement and industry**

<table>
<thead>
<tr>
<th>Assessment type</th>
<th>Type weighting</th>
<th>Task weighting</th>
<th>Assessment task</th>
<th>When</th>
<th>Outcome 1 Geographical inquiry</th>
<th>Outcome 2 Features of places</th>
<th>Outcome 3 People and places</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographical inquiry</td>
<td>20% (CC weighting 20%–30%)</td>
<td>20%</td>
<td>Task 2 Geographical inquiry Climate Change Research Project: Is Perth’s climate changing?</td>
<td>Week 23</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Fieldwork/practical skills</td>
<td>20% (CC weighting 10%–20%)</td>
<td>20%</td>
<td>Task 4 Fieldwork/Practical skills Unseen In-class practical skills investigation—The impacts of climate change: Air pollution</td>
<td>Week 28</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Short and extended responses</td>
<td>30% (CC weighting 25%–35%)</td>
<td>10%</td>
<td>Task 1 Short and extended responses Short answer test: Natural Climate Systems</td>
<td>Week 21</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10%</td>
<td>Task 3 Short and extended responses Extended answer (in-class): The evidence for climate change</td>
<td>Week 26</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10%</td>
<td>Task 5 Short and extended responses Extended answer (in-class Essay): The impact of projected climate change on Australian settlement and infrastructure</td>
<td>Week 29</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Examinations</td>
<td>30% (CC weighting 25%–40%)</td>
<td>30%</td>
<td>Task 6 Mock examination Semester exam (3BGE0): A written examination of three hours. The examination will consist of: 20 multiple-choice 7–9 short answer 2 extended answer responses</td>
<td>Week 31</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
UNIT 3B GEO
Geography of climate change over geological time

TYPE: Geographical inquiry

OUTCOMES:
Outcome 1: Geographical inquiry
Outcome 2: Features of places
Outcome 3: People and places

CONTENT: Place and change; Human influence on sustainability;
Geographical thinking, skills and processes

LEARNING CONTEXT: Urban settlement and industry

TASK 2: Geographical inquiry
Total marks: 40 (20%)

Climate change research project: Is Perth’s climate changing?

With mounting evidence for climate change in the form of retreating glaciers, increased extreme weather events and shifts in the natural world to name a few, the turn of the 21st century sees many societies now living with the early challenges of climate change.

Your task is to write an investigative report which examines the impact of climate change on urban settlement and industry. The context for this report will focus on Perth, Western Australia.

Time for the task
3 weeks (including 4 periods in-class over the semester).

Prior knowledge
Prior to commencing research, it is expected/assumed all students would have completed the class work and accompanying readings from the in-class Units 1–4.

DATA COLLECTION
(a) Select any two current, widely regarded, pieces of evidence for climate change (e.g. rising average annual temperatures, shifts in the natural world, increase in drought) and find the appropriate data for Perth.

(b) Discuss the relevant necessary background that has contributed to the chosen pieces of evidence.
This will include details on:
➢ History
➢ Location (key spots/case studies around WA)
➢ Evidence (data/statistics/photographs etc.)
➢ Importance of the selected evidence (e.g. if the threat of species extinction is apparent, what importance does that particular species play in WA ecosystems?)

(c) Outline the response by the Western Australian State government (at the time) to explain what is being done to deal with the effect/s of climate change and why particular decisions have been/are being made.

(d) Discuss and evaluate the major challenges/issues and strengths of the government response.

(e) Predict what the future will hold for the residents of Perth in terms of climate change.

Note: Your report should include a variety of suitable maps, graphs and statistics to support your findings. All data obtained should be correctly referenced.
INQUIRY PROCESS

1. PLANNING (10 marks)
Conduct an investigation into evidence for climate change in Perth. To achieve this you will need to:

- Use a ‘concept map’ or ‘structured overview’ to record what is already known about evidence for climate change in Perth.
- Develop research questions (general and specific) to guide your research to find out about evidence for climate change in Perth.
- Devise a research plan that outlines your own personal deadlines. This would include details about how and when you would gather information related to your task, writing drafts and producing a final copy of the project.
- Select appropriate and relevant resources (e.g. library resources, the internet etc.).
- Write research notes on your topic. Include maps and statistics wherever possible. Be sure to reference all material used. Adopt different styles of research notes where suitable (e.g. concept map, table, structured overview, heading/point method).

2. CONDUCTING (5 marks)
- Prepare a draft of the report. Thoroughly read, and reread it and/or have a friend critically read it. Edit where appropriate.
- Use the marking key to help guide the research notes and writing.
- Ensure to adhere to the correct report protocols/format.

3. PROCESSING
Information must be processed in the ‘context of the task’. Information and evidence must to be tied to the following areas:

- Evidence for climate change in Perth, Western Australia (max. 2)
- Relevant necessary background that has contributed to the chosen pieces of evidence:
  - The history
  - Location
  - Evidence (Data/statistics/photographs etc.)
  - Importance of the selected evidence
- The WA Government response to climate change to explain what is being done to deal with the effect(s) of climate change.
- Major challenges/issues and strengths of the WA Government response.
- Climate change predictions for the residents of Perth.

Ensure to:
- Critically re-edit the draft for grammatical and spelling errors
- Word process the final draft.

4. COMMUNICATING (20 marks)
Research Project Format: Report
- Present the findings of your investigation as a report ensuring that any conclusions are justified with supporting information, and there is evidence of the use of geographical thinking, skills and processes.
- Correctly record your sources using the referencing guide provided in a ‘References List’.

5. EVALUATION (5 marks)
- Critically reflect on the tasks completed during the research project. Complete a one-page evaluation, critically assessing each step during the task (see handout).
<table>
<thead>
<tr>
<th>What needs to be submitted for assessment</th>
<th>Due dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Concept map or structured overview</td>
<td></td>
</tr>
<tr>
<td>□ Focus research questions</td>
<td></td>
</tr>
<tr>
<td>□ Research plan</td>
<td></td>
</tr>
<tr>
<td>□ Preliminary resources list (must exhibit a variety of sources)</td>
<td></td>
</tr>
<tr>
<td>□ Draft research notes</td>
<td></td>
</tr>
<tr>
<td>□ Draft report</td>
<td></td>
</tr>
<tr>
<td>□ <strong>Final report</strong></td>
<td></td>
</tr>
<tr>
<td>□ A correctly formatted Reference List</td>
<td></td>
</tr>
</tbody>
</table>
Generic marking guide to Part 4

Marking key

INQUIRY PROCESS (15 marks)

<table>
<thead>
<tr>
<th>Geographical inquiry process</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detailed evidence of relevant planning related to the development of a concept map, research plan, research questions, use of numerous appropriate resources, excellent note taking skills and the use and analysis of statistics. A quality draft report is developed</td>
<td>12–15</td>
</tr>
<tr>
<td>Evidence of planning related to the development of a concept map, research plan, research questions, use of appropriate resources, good note taking skills and the use of and analysis of statistics. A good draft report is developed</td>
<td>8–11</td>
</tr>
<tr>
<td>Satisfactory evidence of planning using research questions, use of appropriate resources, note taking and the use of statistics. A satisfactory draft report is developed that needs some editing</td>
<td>5–7</td>
</tr>
<tr>
<td>Basic evidence of planning using simple research questions and a limited number of resources. A draft report developed that needs considerable editing</td>
<td>3–4</td>
</tr>
<tr>
<td>Simple outline of research with no research questions and using minimal resources. Draft report needs to be re-written</td>
<td>1–2</td>
</tr>
<tr>
<td>No evidence of planning. No draft report developed</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>/15</td>
</tr>
</tbody>
</table>

INQUIRY REPORT (25 marks)

<table>
<thead>
<tr>
<th>Geographical Knowledge and Understanding</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly detailed and comprehensive extended discussion which is thorough and integrated. Detailed and accurate reference is made to concepts and theories to the depth and detail required. Critically evaluates the information and the process used to obtain the data. Correctly references all sources used.</td>
<td>12–15</td>
</tr>
<tr>
<td>Detailed and somewhat comprehensive extended discussion which provides sound and relevant information. General reference is made to concepts and theories where appropriate. Some critical evaluation is provided of the information. Correctly references all sources used.</td>
<td>8–11</td>
</tr>
<tr>
<td>General discussion with some relevant and some irrelevant detail. Occasional reference made to concepts and theories. Limited critical evaluation of the information. Some referencing of sources.</td>
<td>5–7</td>
</tr>
<tr>
<td>A basic discussion with little detail. Information might be in dot point form. Very limited reference to concepts and theories. No critical analysis of information. Very basic referencing of sources.</td>
<td>3–4</td>
</tr>
<tr>
<td>A very simple response with minimal relevant detail. No critical analysis of information. Minimal or no referencing of sources.</td>
<td>1–2</td>
</tr>
<tr>
<td>No reference to geographical content. No critical analysis of information. No referencing of sources.</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>/15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evidence used to support extended discussion</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extensive use of detailed and accurate evidence employed in a manner that comprehensively supports the discussion. Uses data (e.g. examples, sources and statistics) that develops and strengthens the discussion.</td>
<td>5–6</td>
</tr>
<tr>
<td>Uses accurate evidence throughout the discussion. Data used to support the discussion.</td>
<td>4</td>
</tr>
<tr>
<td>Evidence is used, some is accurate and supportive.</td>
<td>3</td>
</tr>
<tr>
<td>Limited evidence used and response contains many generalisations.</td>
<td>1–2</td>
</tr>
<tr>
<td>No supportive evidence, OR evidence is incorrect</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>/6</td>
</tr>
<tr>
<td>Geographical communication skills</td>
<td>Marks</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Uses accurate and relevant geographical terms. Well structured sentences and paragraphs that are linked together in a coherent manner.</td>
<td>4</td>
</tr>
<tr>
<td>Uses some appropriate geographical terms. Sentences and paragraphs are well developed and easy to comprehend.</td>
<td>3</td>
</tr>
<tr>
<td>Rarely uses geographical terms. Sentences and paragraphs are simplistic and lack structure and clarity.</td>
<td>2</td>
</tr>
<tr>
<td>Misuses geographical terms. Poor literacy skills reduce the ability of the marker to understand the response.</td>
<td>1</td>
</tr>
<tr>
<td>Make no use of geographical terms. Exceptionally poor literacy skills with poor sentence and paragraph structure. Response makes no sense.</td>
<td>0</td>
</tr>
</tbody>
</table>

**Total** /4
UNIT 3BGEO

Geography of climate change over geological time

**TYPE:** Fieldwork/Practical skills

**OUTCOMES:** Outcome 1: Geographical inquiry
Outcome 2: Features of places
Outcome 3: People and places

**CONTENT:** Place and change; Human influence on sustainability;
Geographical thinking, skills and processes

**LEARNING CONTEXT:** Urban settlement and industry

---

**TASK 4: Short and extended responses**

**Total marks: 44 (10%)**

Unseen in-class practical skills investigation—The impacts of climate change: Air pollution

Analyse and interpret data from a range of sources to write responses to a series of questions that address how a range of cultural patterns and processes and their interaction with selected natural systems affect climate change.

☑ No notes or books are permitted.
☑ No talking or communicating between students.

**Time for the task**

5 minutes reading time and 45 minutes writing time.

**What you need to do**

Students are to analyse and interpret data to assist them in responding to a series of practical skills questions. Students are to attempt ALL questions in the spaces provided.

**Prior knowledge**

Prior to commencing research, it is expected/assumed all students would have completed the class work and accompanying readings from the in-class Units 1–9.

---

**What needs to be submitted for assessment**

<table>
<thead>
<tr>
<th>Due dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Response to the question</td>
</tr>
</tbody>
</table>

See next page for sources and questions.
**TASK 4: In-class practical skills investigation (Unseen)**

How the interaction of cultural patterns and processes on natural systems affect climate change

This task is composed of six extended practical skills questions that address how a range of cultural patterns and processes and their interaction with selected natural systems affect climate change.

Attempt ALL questions in the spaces provided.

**Question 1**

ANALYSE the data in Table 1 to answer the questions which follow:

**Table 1: Air pollution in selected megacities**

For copyright reasons this table cannot be reproduced in the online version of this document.
(a) IDENTIFY the megacity with the 'most serious' air pollution problem. Briefly DISCUSS two implications this problem would have on the heat budget in that megacity.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(5 marks)

(b) DESCRIBE the relationship between population and air pollution.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(4 marks)

(c) Use the data to EXAMINE the composition of air pollution in More Developed Countries (MDC) megacities and Less Developed Countries (LDC) megacities. EXPLAIN the relationship between the nature of air pollution in these cities.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(4 marks)
Question 2
Briefly EXPLAIN how air pollution contributes to global warming.

(3 marks)

Question 3
Transport is one key source of greenhouse gas emissions. DISCUSS the short (immediate) and long-term effects of daily traffic congestion on the Earth’s Greenhouse Gases.

(5 marks)
Question 4

ANALYSE the data in Figure 1 to answer the questions which follow:

Figure 1: Annual greenhouse gas emissions by sector

(a) Which sector is responsible for over half of all $N_2O$ emissions?

(b) ‘Power stations and industrial processes’ account for 50% of which Greenhouse Gas Emission?

(c) What percentage of the ‘waste disposal and treatment’ sector is comprised of $CH_4$?

(d) What percentage of the ‘transportation fuels’ sector is comprised of $CO_2$?

(e) $CO_2$ and $CH_4$ comprise what percentage of the ‘fossil fuels retrieval’ sector?

(5 marks)
Question 5
With reference to the carbon cycle, EXPLAIN how pollutants and aerosols affect climate change.

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
(6 marks)

Figure 2: The Carbon cycle

For copyright reasons this image cannot be reproduced in the online version of this document, but may be viewed at www.starsandseas.com/SAS_images/SAS_ecol_images/SAS_ecol_physical/cycle_carbon_4.jpg.
Question 6
ANALYSE the data in Figure 3 to answer the questions which follow:

Figure 3: Records of changes in atmospheric compositions

(a) ACCOUNT for the dramatic increase in atmospheric compositions since 1700.

_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________

(4 marks)

(b) Briefly EXPLAIN the general trend(s) illustrated in Figure 3.

_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________

(8 marks)
NOTE—When marking a student’s work:

1. Not all points necessarily need to be in an answer for the student to gain full marks.
2. Reward each relevant point made by the student. Students may make different valid points.
3. Students are expected to refer to relevant supporting evidence from the sources.

Question 1
(a) IDENTIFY the megacity with the ‘most serious’ air pollution problem. Briefly DISCUSS two implications this problem would have on the heat budget in that megacity.

(5 marks)

<table>
<thead>
<tr>
<th>Description</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>To obtain five full marks, students are to identify the megacity with the ‘most serious’ air pollution problem and discuss two implications (consequences) a serious air pollution problem would have on the heat budget (natural system) in that chosen megacity.</td>
<td></td>
</tr>
<tr>
<td>The correct identification of the megacity</td>
<td>1</td>
</tr>
<tr>
<td>One implication a ‘serious air pollution problem’ would have on the ‘heat budget’</td>
<td>2</td>
</tr>
<tr>
<td>Second implication</td>
<td>2</td>
</tr>
<tr>
<td>The megacity with the most serious air pollution problem is Mexico City.</td>
<td></td>
</tr>
</tbody>
</table>

Any two of the following types of key pointers contained within a brief discussion for the implications associated with serious air pollution are acceptable:

- Increased SPM would increase the overall percentage of reflective material in the atmosphere, which in turn affects the overall albedo.
- A generalised Heat Budget would assume approximately 5% of dust contained in the atmosphere reflects all insolation. An increase in SPM would increase this percentage and may have long-term implications for average temperatures recorded in that locality.
- In terms of outgoing solar radiation: dust and clouds absorb approx. 18% of all long-wave radiation/heat energy. An increased SPM would possibly absorb more long-wave heat energy.
- Increased albedo will present impacts (short- and long-term) on the overall insolation i.e. the overall Heat Budget percentages (for the pathways of long and short-wave heat energy) for a severely polluted megacity, will vary from other megacities.
- Reduced sunlight can lead to depression in some people; reduced sunlight comes about through the reduced insolation (links to pointers 1 and 2 above).
- Increased haze and the likelihood of photochemical smog.
- Ozone causes breathing difficulties, headaches, fatigue, sinus problems and can aggravate respiratory problems (especially asthma).
- Nitrogen dioxide has links to decreased resistance to infection.

Total mark /5
(b) **DESCRIBE the relationship between population and air pollution.** (4 marks)

<table>
<thead>
<tr>
<th>Description</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>To obtain four full marks, students are to describe (give characteristics of) the relationship (correlation) between population and air pollution.</td>
<td></td>
</tr>
<tr>
<td>General description of characteristics of the relationship</td>
<td>2</td>
</tr>
<tr>
<td>Incorporation of data into description from Table 1</td>
<td>2</td>
</tr>
</tbody>
</table>

Any of the following types of key pointers contained within a brief discussion are acceptable. Students may examine one in great depth or a couple in minor detail. Marker discretion is advised:

- A negative correlation exists; sees one variable increase (population) while the other declines (air quality).
- Large megacities with approx. >15 million people exhibit moderate–heavy to serious pollution problems, particularly LDC megacities.
- LDC megacities such as Mexico City, Cairo and Shanghai exhibit moderate–heavy to serious air pollution problems.
- MDC such as New York City, while exhibiting moderate–heavy air pollution problems associated specifically with transport (CO), all other components of air pollution (SPM, Pb, O₃, NO₂, SO₂) are low, demonstrating the control /successful management of pollution.
- Greater population does not necessarily mean poor air quality/severe air pollution. Many factors play a role in the status of air quality e.g. the country's wealth is very much attributed to the planning management and strategies, technology and education in reducing the effects of severe air pollution, as in the case of New York City.
- Wealth (LDC or MDC) and management of air pollution.

Total mark /4

(c) **Use the data to EXAMINE the composition of air pollution in MDC megacities and LDC megacities. EXPLAIN the relationship between the nature of air pollution in these cities.** (4 marks)

<table>
<thead>
<tr>
<th>Description</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>To obtain four full marks, students are to examine (break into parts and analyse, describe or investigate each one) the composition of air pollution in MDC megacities and LDC megacities.</td>
<td></td>
</tr>
<tr>
<td>A general description of the air pollution composition for LDC megacities and MDC megacities.</td>
<td>1</td>
</tr>
<tr>
<td>A general explanation of the relationship between the nature of air pollution in these cities.</td>
<td>2</td>
</tr>
<tr>
<td>Incorporation of data into examination/description from Table 1</td>
<td>1</td>
</tr>
</tbody>
</table>

Any of the following types of key pointers contained within a brief discussion are acceptable. Students may examine one in great depth or a couple in minor detail. Marker discretion is advised:

- LDC megacities seem to contain more SPM than MDC megacities, as in the case with London and New York City compared with Beijing and Shanghai.
- Lead presents as a heavy to serious air pollution problem in LDC megacities.
- Carbon monoxide is the most serious component of air pollution in MDC megacities.

Total mark /4
Question 2
Briefly EXPLAIN how air pollution contributes to global warming. (3 marks)

Description | Marks
--- | ---
To obtain three full marks, students are to explain (give reasons to show why and how) air pollution contributes to global warming. | 2
Explanation of how air pollution contributes to global warming | 2
Example to elucidate explanation (may include statistics, case studies etc.) | 1
The following type of pointer contained within a brief explanation is acceptable. | 

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Total mark /3

Question 3
Transport is one key source of greenhouse gas emissions. DISCUSS the short (immediate) and long-term effects of daily traffic congestion on the Earth’s Greenhouse Gases. (5 marks)

Description | Marks
--- | ---
To obtain five full marks, students are to discuss (involves both a description and explanation or providing the arguments for and against) the short (immediate) and long-term effects of daily traffic congestion on the Earth's greenhouse gases. | 1
Description of greenhouse gas emissions from transport | 1
Discussion of a short-term (immediate) effect | 2
Discussion of a long-term effect | 2
Any of the following types of key pointers contained within a brief discussion are acceptable. Students may examine one in great depth or a couple in minor detail. Marker discretion is advised:
- The main types of greenhouse gas emissions from transport are carbon monoxide, benzene, nitrogen oxides, methane and particulates
- Long and short-term: a range of health problems (respiratory etc.)
- Increase in SPM in that particular city
- Haze and photochemical smog | 

Total mark /5

Question 4
ANALYSE the data in Figure 1 to answer the questions which follow: (5 marks)

Description | Marks
--- | ---
To obtain five full marks, students are to provide the correct answer from their analyses of data in Figure 1. | 1
One correct answer | 1
The following responses are the correct answers for each part contained in this question:
(a) Agricultural byproducts
(b) Carbon Dioxide (CO₂)
(c) 0.187%
(d) 7.29%
(e) 11% | 1–5

Total mark /5
Question 5
With reference to the carbon cycle, EXPLAIN how pollutants and aerosols affect climate change?
(6 marks)

<table>
<thead>
<tr>
<th>Description</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A comprehensive and highly detailed explanation of how pollutants and aerosols affect climate change. Answer incorporates references to data from fig. 2. Uses accurate and relevant geographical terminology.</td>
<td>4–6</td>
</tr>
<tr>
<td>Correct explanation of how pollutants and aerosols affect climate change. Data from fig. 2 is used but only in a limited manner. Occasionally geographical terminology is used</td>
<td>3–4</td>
</tr>
<tr>
<td>Basic explanation of how pollutants and aerosols affect climate change but with no reference to the data in fig. 2. Rarely uses geographical terminology.</td>
<td>1–2</td>
</tr>
<tr>
<td>Incorrect explanation or no explanation.</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total mark</strong></td>
<td><strong>/6</strong></td>
</tr>
</tbody>
</table>

Material that could be included in the response
Any of the following types of pointers contained within a brief explanation are acceptable. Students may examine one in great depth, or a couple in minor detail. Marker discretion is advised:

- Cars, trucks, and smokestacks also release tiny particles into the atmosphere. These tiny particles are called aerosols. They can be made of different things such as mineral dust, sulfates, sea salt, or carbon. Some of these particles get into the atmosphere naturally. They are dust lifted into the atmosphere from deserts, from evaporating droplets from the ocean, released by the smoke from wildfires, and erupting volcanoes. But air pollution released by humans by burning of fossil fuels also adds them to the atmosphere. Aerosols have an impact on climate. While different types of aerosols act differently in the atmosphere, the overall effect of aerosols is cooling.

- There are little particles in the atmosphere that are so small and light they can float in air. These particles are called aerosols. They may be small but they have the ability to change climate.

- Some aerosols are a natural part of the atmosphere—coming from erupting volcanoes, sea salt, and wildfires. However, burning of fossil fuels like coal, oil, and gas has let lots more aerosols loose in the air. Aerosols are a part of air pollution. They are dangerous to human health and they also dampen the effect of global warming.

- Aerosols in the atmosphere can change the amount of solar energy that is reflected away from Earth. Different types of aerosols react differently when hit with sunlight. Sea salt particles reflect sunlight back out into space. Black carbon particles from burning of wood or fossil fuels absorb most of the sunlight that hits them.

- Aerosols help clouds form and clouds have an impact on climate. The millions of little droplets of water that make up a cloud each need a little particle, like an aerosol, to condense upon. More aerosols can create more clouds. Different types of clouds may have different impacts on climate and this is a topic that scientists are still exploring. But in general, clouds reflect incoming solar radiation back out to space.
Question 6
ANALYSE the data in Figure 3 to answer the questions which follow:

(a) ACCOUNT for the dramatic increase in atmospheric compositions since 1700. (4 marks)

<table>
<thead>
<tr>
<th>Description</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>To obtain four full marks, students are to account (give the reasons to show how and why some trend occurs) for the dramatic increase in atmospheric compositions since 1700.</td>
<td></td>
</tr>
<tr>
<td>An account of why the graphs indicate a dramatic increase in atmospheric concentrations since 1700</td>
<td>2</td>
</tr>
<tr>
<td>Incorporation of data into account from Figure 3</td>
<td>2</td>
</tr>
<tr>
<td>Any of the following types of pointers contained within a brief explanation are acceptable. Students may examine one in great depth, or a couple in minor detail. Marker discretion is advised:</td>
<td></td>
</tr>
<tr>
<td>• The onset and ensuing period of the Industrial Revolution.</td>
<td></td>
</tr>
</tbody>
</table>

Total mark /4

(b) Briefly EXPLAIN the general trend/s illustrated in Figure 3. (8 marks)

<table>
<thead>
<tr>
<th>Description</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>To obtain four full marks, students are to describe the general trends illustrated in Figure 3.</td>
<td></td>
</tr>
<tr>
<td>Identification of the general trends in all four graphs</td>
<td>4</td>
</tr>
<tr>
<td>Explanation of the general trends in all four graphs</td>
<td>2</td>
</tr>
<tr>
<td>Incorporation of data into account from Figure 3</td>
<td>2</td>
</tr>
<tr>
<td>Any of the following types of pointers contained within a brief explanation are acceptable. Students may examine one in great depth, or a couple in minor detail. Marker discretion is advised:</td>
<td></td>
</tr>
<tr>
<td>• The four graphs for carbon dioxide, methane, nitrous oxide and sulphur all exhibit sharp increases in greenhouse gas concentrations.</td>
<td></td>
</tr>
<tr>
<td>• Fuels associated with the machinery during the onset of the Industrial Revolution and the ensuing years saw an increase in contributions of greenhouse gas emissions, and as populations and machinery grew, so did the rate at which gases were released into the atmosphere.</td>
<td></td>
</tr>
</tbody>
</table>

Total mark /8
UNIT 3B GEO
Geography of climate change over geological time

TYPE: Short and extended responses (in-class essay)

OUTCOMES: Outcome 1: Geographical inquiry
Outcome 3: People and places

CONTENT: Place and change; Geographical thinking, skills and processes

LEARNING CONTEXT: The impact of projected climate change on human settlement in Australia

**TASK 5: Short and extended responses (In-class essay)**

<table>
<thead>
<tr>
<th>Climate change essay: Potential impacts of climate change on settlement and structure.</th>
</tr>
</thead>
</table>

The impacts of climate change on settlements and infrastructure are likely to be widespread. Vulnerability to climate change will vary considerably from settlement to settlement and within settlements. The type, size and structure, location, socioeconomic characteristics and institutional arrangements are key factors that affect vulnerability and adaptive capacity of a settlement.

Your task is to:

Examine the impact of projected climate change upon Australian settlement and infrastructure with reference to **any three** of the following forms of evidence:

(a) Increases in temperature
(b) Altered rainfall patterns
(c) Altered frequency of extreme weather events
(d) Sea level rise.

**Time allocation**

50 minutes.

**Prior knowledge**
To successfully complete this essay, all unit content under ‘Place and change’ must have been studied.

**Special requirements**
This task is completed at the commencement of Week 14, giving you full advantage of almost one complete semester of research and study on climate change. For this reason, no notes are allowed to accompany you whilst writing the in-class essay.
### TASK 5—Marking key

<table>
<thead>
<tr>
<th>Geographical Content/Thinking</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly detailed and comprehensive extended discussion which provides thorough and</td>
<td>13–15</td>
</tr>
<tr>
<td>integrated accounts of features, activities, patterns, processes, relationships and factors</td>
<td></td>
</tr>
<tr>
<td>which are in-depth and consistent. Detailed and accurate reference made to concepts and</td>
<td></td>
</tr>
<tr>
<td>theories to the depth and detail required.</td>
<td></td>
</tr>
<tr>
<td>Detailed and somewhat comprehensive extended discussion which provides general information</td>
<td>10–12</td>
</tr>
<tr>
<td>of features, activities, patterns, processes, relationships and factors which are accurate</td>
<td></td>
</tr>
<tr>
<td>and consistent. General reference made to concepts and theories where appropriate.</td>
<td></td>
</tr>
<tr>
<td>Sound extended discussion with some relevant and some irrelevant detail. Occasional reference</td>
<td>7–9</td>
</tr>
<tr>
<td>made to concepts and theories</td>
<td></td>
</tr>
<tr>
<td>A basic discussion with little detail. Information might be in dot point form. Very limited</td>
<td>4–6</td>
</tr>
<tr>
<td>reference to concepts and theories</td>
<td></td>
</tr>
<tr>
<td>A very simple response with minimal relevant detail</td>
<td>1–3</td>
</tr>
<tr>
<td>No reference to geographical content</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>/15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evidence used to support extended discussion</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extensive use of detailed and accurate evidence employed in a manner that comprehensively</td>
<td>8–10</td>
</tr>
<tr>
<td>supports the discussion. Uses data (e.g. examples, sources and statistics) that develops and</td>
<td></td>
</tr>
<tr>
<td>strengthens the discussion.</td>
<td></td>
</tr>
<tr>
<td>Uses accurate evidence throughout the discussion. Data used to support the discussion.</td>
<td>5–7</td>
</tr>
<tr>
<td>Evidence is used, some is accurate and supportive.</td>
<td>3–4</td>
</tr>
<tr>
<td>Limited evidence used and response contains many generalisations.</td>
<td>1–2</td>
</tr>
<tr>
<td>No supportive evidence, OR evidence is incorrect</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>/10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Geographical communication skills</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses accurate and relevant geographical terms. Well structured sentences and paragraphs that</td>
<td>4–5</td>
</tr>
<tr>
<td>are linked together in a coherent manner.</td>
<td></td>
</tr>
<tr>
<td>Uses some appropriate geographical terms. Sentences and paragraphs are well developed and</td>
<td>3</td>
</tr>
<tr>
<td>easy to comprehend.</td>
<td></td>
</tr>
<tr>
<td>Rarely uses geographical terms. Sentences and paragraphs are simplistic and lack structure</td>
<td>2</td>
</tr>
<tr>
<td>and clarity.</td>
<td></td>
</tr>
<tr>
<td>Misuses geographical terms. Poor literacy skills reduce the ability of the marker to</td>
<td>1</td>
</tr>
<tr>
<td>understand the response.</td>
<td></td>
</tr>
<tr>
<td>Make no use of geographical terms. Exceptionally poor literacy skills with poor sentence</td>
<td>0</td>
</tr>
<tr>
<td>and paragraph structure. Response makes no sense.</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>/5</td>
</tr>
<tr>
<td><strong>Total marks</strong></td>
<td>/30</td>
</tr>
</tbody>
</table>
1. **Content**
   - Students are to refer to the impact of projected climate change on Australian settlement and infrastructure.
   - Students are to include any three of the following pieces of evidence for climate change in their examination:
     - (a) increases in temperature
     - (b) altered rainfall patterns
     - (c) altered frequency of extreme weather events
     - (d) sea level rise.
   See pointers in the table below for typical discussions.
     - Reference must be made to Australian settlement and infrastructure
     - High marks awarded to students who engage in a specific Australian case-study throughout their essay
     - Meaningful sketches incorporated into the discussion are to be awarded.

<table>
<thead>
<tr>
<th>Students may make reference to any of the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note: <em>This list is not exhaustive</em></td>
</tr>
</tbody>
</table>

**A.**

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**B. Altered rainfall patterns:**

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**C. Altered frequency of extreme weather events:**

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**D. Sea level rise:**

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REFERENCES

Student texts:


Teacher references:


**NOTE:** The resources or references such as texts and websites in this document are provided as examples of resources that teachers can use to support their teaching. Their inclusion does not imply that they are mandatory, preferred or that they are the only resources relevant to the course.
ACKNOWLEDGEMENTS

Task 4


Marking guide: Practical skills


TASK 5—Marking key