 Sustainable Biomes

Stage 5 Geography

Key inquiry questions

* What are the main characteristics that differentiate the world’s biomes?
* How do people use and alter biomes for food production?
* Can the world’s biomes sustainably feed the world’s population?
* What strategies can be used to increase global food security?

Overview

Students:

* examine the physical characteristics and productivity of biomes
* examine the correlation between the world’s climatic zones and spatial distributions of biomes and their capacity to support food and non-food agricultural production
* analyse the impact humans have on biomes in an effort to produce food and increase agricultural yields
* examine population trends and projections from Australia and across the world and forecast future food supply-and-demand issues
* investigate challenges to food production are explored and management strategies.

Outcomes

A student:

* explains the diverse features and characteristics of a range of places and environments GE5-1
* explains processes and influences that form and transform places and environments GE5-2
* analyses the effect of interactions and connections between people, places and environments GE5-3
* assesses management strategies for places and environments for their sustainability GE5-5
* acquires and processes geographical information by selecting and using appropriate and relevant geographical tools for inquiry GE5-7
* communicates geographical information to a range of audiences using a variety of strategies GE5-8

Outcomes and other syllabus material referenced in this document are from:

* [Geography K-10 Syllabus](http://syllabus.nesa.nsw.edu.au/hsie/geography-k10/) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2015

Teaching and learning activities

Inquiry questions

For each key inquiry question, students are encouraged to design their own inquiry questions as a subset in order to complete the geographical inquiry process which forms the bases of these teaching and learning sequences.

Assessment

The strategies require students to demonstrate their learning and are all either assessment for learning or assessment as learning activities. Some activities might be selected and included in a school assessment schedule for assessment of learning.

Syllabus references

Biomes

Students:

* investigate the distribution and physical characteristics of biomes (ACHGK060)
  + examination of the spatial distribution of biomes
  + identification of biomes used to produce food, industrial materials and fibres

Changing biomes

Students:

* investigate the human alteration of biomes to produce food, industrial materials and fibres and the environmental effects of these alterations, for example: (ACHGK061)
  + examination of human alterations to the physical characteristics of biomes agriculture, land terracing, irrigation, mining
  + assessment of environmental impacts of human alterations to biomes
  + discussion of successful sustainability strategies that minimise environmental impacts

Biomes produce food

Students:

* investigate environmental, economic and technological factors that influence agricultural yields in Australia and across the world, for example: (ACHGK062)
  + examination of how environmental factors influence agricultural yields
  + discussion of economic factors affecting agricultural yields commercialisation of agriculture
  + explanation of how technology is used to increase agricultural yields

Challenges to food production

Students:

* investigate environmental challenges to food production for Australia and other areas of the world, for example: (ACHGK063)
  + description of the impact of environmental challenges on food production
  + assessment of the extent to which climate change can affect the capacity of countries to increase food production

Food security

Students:

* investigate the capacity of the world’s biomes to achieve sustainable food security for Australia and the world, for example: (ACHGK064)
  + assessment of the capacity of biomes to produce food into the future
  + analysis of population projections to predict future demand for food
  + examination of sustainable practices used to achieve food security
  + discussion of the potential for Australia to contribute to global food security

Learning sequence 1

* Biomes
* Changing biomes
* Biomes produce food

Key inquiry question

* How do environments function? (from Environmental Change and Management)

Teacher introduction

Teacher introduction – introduce students to:

* the four interacting natural environment spheres – biosphere, atmosphere, hydrosphere and lithosphere and their corresponding processes
* ecosystems including a simple model
* biomes\*.

\*Note that for the purposes of the syllabus, biomes and natural environments are synonymous, with the exception of anthropogenic biomes- or predominantly human altered terrestrial biomes, and this can be seen in the list below. The focus on the syllabus, is, however, the natural, climate related biomes.

Key inquiry question

* What are the main characteristics that differentiate the world’s biomes?

You have been invited by an IT company to design a virtual fieldwork excursion to a biome, with a focus on one natural biome in particular. The fieldwork will be aimed at Stage 5 students and can be in any form, but will include a summary of the work researched below.

Your task is to form groups and decide on the biome that you are going to research and use as the basis of your virtual fieldwork (i.e. aquatic or land or ice). For example:

* aquatic
  + oceans
  + rivers
  + coral reefs
  + wetlands
* land (terrestrial)
  + rainforests
  + grasslands
  + tundra
  + woodlands
  + deserts
  + coasts
* “Antarctic”\*\*
  + ice
  + anthropogenic
  + dense settlements
  + villages
  + croplands
  + forested lands

\*\*Antarctica’s biome can be classified as an “ice biome” but more recently it is known as being its own unique biome.

Each member of the group will choose an ‘area of expertise’ from below. They will research this area, covering the points outlined and devise that part of the virtual fieldwork that teaches students about it.

Remember that source material has to be evaluated for reliability or bias before being used.

The areas of expertise to be selected and information to be covered by individual group members include the:

1. Spatial distribution of the specific biome
   * Locate the spatial distribution of the biome on a map of the world.
   * Identify the physical characteristics of the biome.
   * Describe the typical climate of the biome.
2. Flora and fauna of the specific biome
   * Identify some of the unique flora and fauna found in the biome.
   * Describe how the flora and fauna have adapted to the physical characteristics and climate of the biome.
   * Explain the relationship between the flora and fauna within the biome.
3. Human interactions with the specific biome
   * Identify and describe one community that lives within, or as part of, the biome. If possible, choose a community that is indigenous to this biome. In your response, provide some data about population numbers, lifestyle and use of the biome in everyday life, as well as a climatic graph to indicate the typical climatic conditions for this community.
4. Resources of the biome
   * Identify the resources that come from the chosen biome.
   * List, and give reasons for, industries that rely on this biome.
   * For two resources identified, outline the processes that lead to their formation.
   * Summarise the benefit of each of the resources to you, including the properties of the resources.
5. Changing biome
   * Describe the alterations that have been made to the physical characteristics of the biome, because of human activity.
   * Assess the consequences of these alterations for the biome.
   * Suggest a number sustainable strategies that could be used which would reduce the impact of the alterations on the biome.

Now, when you have the information, draft the virtual fieldwork concept, consider factors like:

* what are the main ideas within each area of expertise
* how the students are going to learn
* set up and design
* what electronic equipment will be required for others to undertake the virtual fieldwork.

Once the virtual fieldwork has been designed and implemented, each group will ‘go’ on a number of virtual biome excursions. Students will allocate marks for each based on their experiences. Half of the mark will be for information learned, and the other half will be based on how well the virtual fieldwork was designed.

Discuss the final marks as a class. Students can be asked to discuss the experience in terms of assessment as learning.

Learning sequence 2

* Challenges to food production
* Food security

Key inquiry question

* How do people use and alter biomes for food production?

Teacher introduction

Discuss/review general examples of social, technological, economic, political, environmental, and physical factors when researching from a geographical point of view.

Class collaboration – research and create a visual representation to illustrate the factors that influence agricultural yields in the world and show specific Australian examples within the representation.

Report for Department of Agriculture\*

(\* Possible assessment task - see outcomes, rubric and marking criteria at the end of this document.)

You have been asked to develop a case study based report for the Department of Agriculture about the factors that influence food production in Australia and throughout the world; and how these factors have the potential to increase or decrease food security (challenges to food production). You will use a specific product as an example. The Department of Agriculture has asked that the report focus particularly on technological factors and climatic challenges related to food production. This report will be provided to inform future generations of farmers not just in Australia, but throughout the world.

Teachers’ note

This activity could first be provided to students as a class case study, using a product produced in the Asia-Pacific region, to demonstrate what is later expected of the task below.

* To complete your report you will need to do a case study of one crop grown in Australia.
* Select an agricultural crop (e.g. rice, wheat, oranges) that is grown in Australia.
* Identifies where in Australia the crop is produced, and used, including giving an overall case study of the geography of the specific crop you have chosen (map of the region, statistical data).
* Demonstrate the supply chain of the crop from the farm to the table in written or graphical form.
* Discuss Australia’s use of the crop (e.g. Export/domestic consumption).
* Outline the various factors that specifically influence the yield, positively and negatively, of your chosen crop.
* Identify and discuss how technology is assisting to address the challenges being faced by the agricultural sector in producing this crop.
* Investigate, in greater detail, the environmental challenges of producing this crop (climate, water, soil, topography) .
* Explore the various strategies that have been introduced to improve the agricultural yields of the crop.

Your report must be very succinct and should be no longer than 1500 words, excluding graphs and maps, and must use the following structure:

* table of contents
* list of maps, graphs and tables
* introduction to the report - what does this report aim to tell farmers
* method – how and where you obtained your information – for example through interviews, internet, newspaper articles etc.
* findings – report these using sub-headings such as “Factors that influence agricultural yields of [chosen crop]” and “Environmental challenges of producing [chosen crop]”.
* conclusion – what your investigation found out for farmers, especially in light of environmental challenges
* recommendations – any recommendations that could be made to farmers of the future to ensure sustainability of the chosen crop
* references – a list of the information sources that you used in the report (ensure you check for validity and bias before you using them)
* appendix – any additional information that is not used in your report but is still vital.

Learning sequence 3

Key inquiry questions

* Can the world’s biomes sustainably feed the world’s population?
* What strategies can be used to increase global food security?

Question and Answer (Q&A) - Food Security Summit

You have been invited, in your capacity as an expert in your chosen field (see below), to attend a Global Forum that is only held once a decade. This time, the forum will focus on rice growing. The F2S2R – Future Food Security Summit – Rice, aims to assess the current capacity of biomes to produce this food and to predict and analyse issues that may occur in the next decade.

Your teacher will allocate, or allow you to select, one of the following expert roles:

* Australian farmer – runs a well-established dry rice farm in the Leeton, in the Riverina region of NSW. Has export contracts with Singapore, Brunei and New Zealand importers.
* Asian farmer – located on the island of Lombok in Indonesia. Has been invited by Australian Government to share his/her traditional sustainable rice growing practices that have ensured consistent crop yields despite increasing competition for resources.
* Aboriginal elder – in cooperation with the Asian farmer, is outlining to the forum how traditional sustainable practices could be more beneficial in terms of export markets, product yields and land quality.
* Department of Agriculture scientist – wants to introduce a new fertiliser that involves a genetically modified product that contradicts traditional methods and could impact on export contracts.
* WHO representative – wants to ensure the health and wellbeing of the regional and global population
* Global Seed Bank representative – has grant money to give to participants with good ideas who work with the aims and objectives outlined by the Food and Agricultural Organization of the United Nations (FAO).
* CSIRO representative – cranky because she/he is being overlooked and their expertise, time and money has not been valued.
* Non-government organisation (NGO) representative – wants the production of rice to double as this will lead to a reduction in grain prices to people ensuring a more accessible product.
* Food and Agricultural Organization of the United Nations (FAO) representative – whose role is to coordinate trade agreements between the main stakeholders.
* Hindu priest – outlines the cultural perspective of rice in Hinduism over time and place, and needs to ensure its security into the future.

Your role is to negotiate with other experts to devise a collaborative five point plan that will predict:

1. the demand for rice in future
2. the capacity of Australia and the world to produce rice into the future
3. two new sustainable practices that may increase rice security
4. the role of Australia in contributing to global food/rice security
5. where future food/rice demand is most likely to be needed (in Australia and the world).

Before negotiation commences, you must prepare an introductory document that summarises, in general, food security in Australia in comparison to global food security. The summary will serve as a prelude to your five-point plan.

The summary should:

* contain information from a variety of sources
* be clear and concise
* demonstrate a knowledge and understanding of definitions related to food security.
* conclude with no more than ten concerns that you will discuss with other experts and that will inform the negotiated five point plan.

You should add to your introductory document a one-page biography of your role as an expert in this area, as well as a paragraph or two about the importance of rice farming now and for the future. This will require research using a variety of source material that needs to be acknowledged.

Finally, your document will include a draft five-point plan that you will need to take at the summit, for negotiation.

Summit – you are, as a one of the chosen experts, to talk and negotiate with the other experts in the field about your concerns for rice farming and the validity of your draft five-point plan. Make any adjustments to your plan as a consequence of your negotiation and what you have learned from the other experts.

Finalise your five-point plan.

Teachers’ note – students should discuss all plans and conclude with a class consensus about the future issues and concerns of sustainable rice growing, and the link to global food security.

Resources

Learning sequence 1

* [Blue Planet page on world biomes](http://www.blueplanetbiomes.org/world_biomes.htm)
* [World Food Programme website](http://www.wfp.org/students-and-teachers/classroom-activities)
* [WWF webpage on major biomes of the world](http://wwf.panda.org/about_our_earth/teacher_resources/webfieldtrips/major_biomes/)
* [GeogSpace webpage on biomes and ecosystems](http://www.geogspace.edu.au/core-units/years-9-10/exemplars/year-9/y9-exemplars-y9-illus1.html)
* [Eden Project webpage on the world's largest greenhouse](http://inhabitat.com/eden-project-giant-bubble-biomes-are-worlds-largest-greenhouse/)
* [Workbook – biomes that produce our food, industrial materials and fibre](http://cottonaustralia.com.au/uploads/resources/Year_9_-_Biomes_that_produce_our_food,_industrial_materials_and_fibre.pdf)
* [Presentation on food security](http://gtansw.org.au/files/resources/2013/Food%20Security%20-%20web.pdf)
* [Scootle](https://www.scootle.edu.au/)
* [Article from the Australian Institute of Family Studies – 'Food insecurity in Australia'](https://aifs.gov.au/cfca/publications/food-insecurity-australia-what-it-who-experiences-it)
* [Caritas webpage on food security, sovereignty and sustainable agriculture](http://www.caritas.org.au/learn/global-poverty-issues/food-security-and-sustainable-agriculture)

Learning sequence 2

* [Food First webpage on food security](http://www.foodsecuritynews.com/What-is-food-security.htm)
* [Global Education webpage on food security](http://www.globaleducation.edu.au/global-issues/gi-food-security.html)

Geographical terminology

Review

* altitude
* latitude
* longitude
* precipitation
* habitat
* sustainability
* climatic graph

New

* atmosphere
* biosphere
* lithosphere
* hydrosphere
* biome
* anthropogenic biome
* aquatic biomes
* terrestrial biomes
* natural environments
* spatial distribution
* climate
* biodiversity
* agricultural yield
* agricultural productivity
* Net Primary Productivity (NPP)
* environmental impact
* agricultural yield
* “food bowl”
* food security
* Green Revolution
* sustainable production
* High Yielding Varieties
* crop yield
* environmentally sustainable
* sustainable agriculture
* Millennium Development Goals (MDGs)
* Universal Declaration of Human Rights (UDHR)

Concepts, inquiry skills and tools

Geographical concepts

The following geographical concepts have been integrated into the teaching and learning sequence:

* Place – the significance of biomes and their specific characteristics; the reasons why crop production differs between biomes; the reasons why food security differs between places.
* Space – the spatial distribution of biomes and how they are altered and managed; the spatial distribution of specific crops in Australia and throughout the world; the spatial distribution of the consumption of food throughout the world.
* Environment – the environmental impacts of the use of technology on crops produced; the important interrelationships between humans and biomes for the production of food.
* Interconnection – the interconnections between biomes, food production and the environment; the interconnections between food security and cultures.
* Scale – the impact of technology and environmental factors on biomes at a variety of scales; the difference in food security at a variety of scales.
* Sustainability – the sustainable production of food; the sustainable management of biomes
* Change – changing biomes over time; the factors that have led to an increase or decrease in crop yields; changing rates of food consumption over time.

Geographical inquiry skills

The following geographical inquiry skills have been integrated into the unit.

Acquiring geographical information

* develop geographically significant questions and plan an inquiry that identifies and applies appropriate geographical methodologies and concepts (ACHGS063, ACHGS072)
* collect, select, record and organise relevant data and geographical information, using ethical protocols, from a variety of appropriate primary data and secondary information sources (ACHGS064, ACHGS073)

Processing geographical information

* evaluate information sources for their reliability, bias and usefulness (ACHGS065, ACHGS074)
* represent multi-variable data in a range of appropriate forms, with and without the use of digital and spatial technologies (ACHGS065, ACHGS074)
* represent the spatial distribution of geographical phenomena on maps that conform to cartographic conventions, using spatial technologies as appropriate (ACHGS066, ACHGS075)
* evaluate multi-variable data and other geographical information using qualitative and quantitative methods and digital and spatial technologies as appropriate to make generalisations and inferences, propose explanations for patterns, trends, relationships and anomalies, and predict outcomes (ACHGS067, ACHGS076)
* apply geographical concepts to synthesise information from various sources and draw conclusions based on the analysis of data and information, taking into account alternative perspectives (ACHGS068, ACHGS077)
* identify how geographical information systems (GIS) might be used to analyse geographical data and make predictions (ACHGS069, ACHGS078)

Communicating geographical information

* present findings, arguments and explanations in a range of appropriate communication forms selected for their effectiveness and to suit audience and purpose, using relevant geographical terminology and digital technologies as appropriate (ACHGS070, ACHGS079)
* reflect on and evaluate the findings of an inquiry to propose individual and collective action in response to a contemporary geographical challenge, taking account of environmental, economic and social considerations; and explain the predicted outcomes and consequences of their proposal (ACHGS071, ACHGS080)

Geographical tools

The following geographical tools have been integrated into the unit.

Maps

* relief maps, political maps, topographic maps, choropleth maps, flowline maps, cadastral maps, thematic maps, isoline maps, land use maps, précis maps, special-purpose maps, cartograms, synoptic charts
* maps to identify direction, scale and distance, area and grid references, degrees and minutes of latitude and longitude, bearings, aspect, altitude, area, density, contour lines, gradient, local relief

Fieldwork

* observing, measuring, collecting and recording data, developing and conducting surveys and interviews
* fieldwork instruments such as weather instruments, vegetation identification charts, compasses, clinometers, GPS, GIS or remote sensing

Graphs and statistics

* data tables, pie graphs, column graphs, compound column graphs, line graphs, scatter graphs, climate graphs, population profiles, multiple tables and graphs presented on a geographical theme, statistics to find patterns and trends, and to account for change

Spatial technologies

* virtual maps, satellite images, global positioning systems (GPS), geographic information systems (GIS), remote sensing data, augmented reality

Visual representations

* photographs, aerial photographs, illustrations, flow charts, annotated diagrams, multimedia, field and photo sketches, cartoons, mind maps, web tools

Assessment task and rubric

Outcomes

* assesses management strategies for places and environments for their sustainability GE5-5
* acquires and processes geographical information by selecting and using appropriate and relevant geographical tools for inquiry GE5-7
* communicates geographical information to a range of audiences using a variety of strategies GE5-7

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* references – a list of the information sources that you used in the report (ensure you check for validity and bias before you using them)
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Rubric

9-10 marks

* Provides comprehensive geographical information about Australian locations of production and use.
* Investigates environmental challenges facing producers in great detail and provides supporting evidence.
* Identifies current strategies that have been introduced to improve agricultural yields of the product.
* Discusses in detail the advances used to address challenges facing the agricultural sector.

7-8 marks

* Provides detailed geographical information about Australian locations of production and use.
* Investigates environmental challenges facing producers in detail and provides supporting evidence.
* Identifies current strategies that have been introduced to improve agricultural yields of the product.
* Discusses the advances used to address challenges facing the agricultural sector.

5-6 marks

* Provides some geographical information about Australian locations of production and use.
* Investigates some environmental challenges facing producers and provides supporting evidence.
* Identifies some current strategies that have been introduced to improve agricultural yields of the product.
* Discusses some of the advances used to address challenges facing the agricultural sector.

3-4 marks

* Provides basic geographical information about Australian locations of production and use.
* Investigates some environmental challenges facing producers and provides limited supporting evidence.
* Identifies a few current strategies that have been introduced to improve agricultural yields of the product.
* Discusses a few of the advances used to address challenges facing the agricultural sector.

1-2 marks

* Provides limited geographical information about Australian locations of production and use.
* Identifies some environmental challenges facing producers.
* Identifies limited strategies that have been introduced to improve agricultural yields of the product.
* Provides limited information about advances used to address challenges facing the agricultural sector.