

Farrer High School- Cultivating Classrooms Professional Development

NSW DPI Schools Team

Find all our resources at: <https://www.nswdpi-schools-program.com/>

Climate resources

The Climate Challenge PD- Online \$150 (in the process of seeking NESA accreditation) 6 hrs
<https://www.nswdpi-schools-program.com/teacher-professional-development>

- Description** This course will assist teachers of Agriculture and Primary Industries subjects in NSW to deliver up to date information related to weather and climate change. It specifically addresses the Stage 6 Agriculture elective *The Climate Challenge* but also provides general information in relation to the main drivers of weather patterns in Australia, impacts of climate change to our agricultural systems and risk management techniques. (Will be useful for new climate content in upcoming new Stage 5 syllabus)
 - Includes:**
 - 6 learning modules Each module includes a range of activities and information sources, and course notes to help you learn about climate, how climate variability affects agricultural production and risk management techniques.
 - An overview of weather and climate (1.5 hours)
 - Australia's variable climate (1 hour)
 - Climate variability (1 hour)
 - Managing processes in agricultural systems (1 hour)
 - Research into climate variability (0.5 hours)
 - Create your own fully resources teaching and learning unit program (1 hour)
 - Writeable students study guide covering all HSC elective outcomes and content (dot points) and past HSW questions
 - Example program (matching the study guide)
- Here's a sneak peak at the students workbook and learning modules

NSW Department of Primary Industries
Climate challenge
 Supporting document
 NSW DPI Schools Program

www.dpi.nsw.gov.au

Climate Challenge

- Overview 5
- Past systems and farm events 5
- HSC notes and key words 6
- Introduction, ethics and consent issues 7
- 1.1 Australia's variable climate 7
 - Compare the variability of climate in different geographical regions in Australia 7
 - Examine using secondary sources, climate of the local area and of a contrasting Australian region 7
 - Calculate the mean and sample standard deviation of rainfall and maximum and minimum temperature over the past 50 years for the local area and for a contrasting region in Australia 10
 - Analyse data to determine the frequency of wet, normal and dry years, hot, normal and cool years for the local area and for a contrasting region in Australia 12
 - Explain the implications of climate variability for agricultural production 15
 - Extrapolate from climate variability data to determine the effects of climate change on production 16
 - Investigate research evidence in relation to long term climate variation such as ice ages and tree growth rings 18
- 1.2 Causes of climate variability 18
 - Outline the effects sea surface temperature and the Southern Oscillation Index (SOI) have on climate in Australia 21
 - Describe the processes causing the climate events of La Niña and El Niño 14
 - Analyse the variations in crop yields in Australia with changes in SOI 16
- 1.3 Changes in climate that may be attributed to human activity 18
 - Identify the sources of greenhouse gas emissions 41
 - Identify carbon dioxide, methane and nitrous oxide as the three main greenhouse gases 44
 - Explain the effect of greenhouse gases on atmospheric temperature and climate change 46
 - Explain the contribution of nitrogen fertilizer and intensive ruminant production to greenhouse gas production 48
 - Explain how vegetation changes and land clearing can affect local climate 48
- Managing processes in agricultural systems 48
 - 2.1 Managing resources 48
 - Describe methods used to store and trade water resources 48
 - Analyse issues related to water storage and trading including trout flows, siltation, degradation and enterprise flexibility 48
 - Identify methods which can be used in agricultural systems to reduce the concentration of greenhouse gases in the atmosphere 49
 - Describe methods farmers can use to reduce methane emissions from ruminant livestock 49
 - Outline methods used to sequester carbon in agricultural soils 51

The Climate Challenge Workbook

Annual mean maximum and minimum temperature (°C)

The annual mean maximum temperature is calculated by averaging the monthly mean maximum for each month. Monthly mean maximum temperature is the average of all available daily maximum temperatures for the month. The Daily maximum air temperature is the highest temperature for the 24 hours leading up to the observation.

The annual mean minimum temperature is calculated by averaging the monthly mean minimum temperature for each month. The monthly mean minimum temperature is the average of all available daily minimum temperatures for the month. The Daily minimum air temperature is the lowest temperature for the 24 hours leading up to the observation.

Figure 2 and 3 show annual mean maximum and minimum temperatures for Orange Agricultural Institute and Corbould Agricultural Research Station. The tables have been colour coded to group temperature over time in °C increments.

Key for Figure 2 and 3:

Annual mean maximum temperature	Annual mean minimum temperature
80.0-84.9°C	10.0-14.9°C
85.0-89.9°C	15.0-19.9°C
90.0-94.9°C	20.0-24.9°C
95.0-99.9°C	25.0-29.9°C
100.0-104.9°C	30.0-34.9°C
105.0-109.9°C	35.0-39.9°C
110.0-114.9°C	40.0-44.9°C
115.0-119.9°C	45.0-49.9°C
120.0-124.9°C	50.0-54.9°C

Figure 3 Annual mean maximum and minimum temperature for Orange Agricultural Institute

Year	Annual mean maximum temperature (°C)	Annual mean minimum temperature (°C)
1976	162.1	6.1
1977	162.1	6.1
1978	162.1	6.1
1979	162.1	6.1
1980	162.1	6.1
1981	173.9	6.2
1982	166.0	6.3
1983	172.5	7.6
1984	164.5	6.4
1985	172.5	6.5
1986	172.5	6.5
1987	172.5	6.5
1988	172.5	6.5
1989	162.1	6.6
1990	172.5	6.7
1991	162.1	7.2
1992	172.5	6.3
1993	172.5	7.2
1994	172.5	6.3
1995	172.5	6.3
1996	172.5	6.3
1997	172.5	6.3

Students workbook

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1988	172.5	6.5
1989	162.1	6.6
1990	172.5	6.7
1991	162.1	7.2
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1993	172.5	7.2
1994	172.5	6.3
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The Climate Challenge Workbook

Syllabus point
Investigate research evidence in relation to long-term climate variation such as ice cores and tree growth rings.

Key concept
The growth rings

Read the following article: [This ring provides evidence of Earth's past climate](#). [Download climate change](#). [View sign of the times](#).

16/01/2020 January 20, 2020
How tree growth responds to Earth's past climate
By Jessica Sjöller-Cronin

If you look at the window you can tell it's very sunny right now, but that doesn't say very much about your region's climate—the exact weather conditions over a long period of time (20 years or more). However, that tree in your backyard has been keeping a detailed record for decades. These can be hundreds—and sometimes even thousands—of years. One tree's long lifetime, a tree can experience a variety of environmental conditions: wet years, dry years, cold years, hot years, early frosts, forest fires and more.

But how do trees keep track of this information?

Tree ring growth
A tree's growth rings are formed by the cambium, a layer of cells that produces secondary xylem. The cambium grows in a ring around the trunk of the tree, and as it grows, it adds new layers of wood to the trunk. The width of each ring varies depending on the weather conditions during the year. In a wet year, the cambium grows more rapidly, creating a wider ring. In a dry year, it grows more slowly, creating a narrower ring. The width of the rings can be used to determine the amount of rainfall during the year.

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How tree growth responds to Earth's past climate
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If you've ever been in a forest, you've probably noticed that the top of a stump has a series of concentric rings. These rings tell us about the weather and climate conditions over a long period of time. The light-colored rings represent wood that grew in the spring and early summer, while the dark rings represent wood that grew in the late summer and fall. One light ring plus one dark ring equals one year of the tree's life. Because trees are so long-lived, they can provide a detailed record of the weather and climate conditions over hundreds of years. For example, tree rings usually grow wider in wet years and narrower in years when it is cold and dry. If the tree has experienced drought conditions, such as a drought, the tree might grow at all in those years.

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Fig. 16.16 Ice core data from the EPICA Dome C (EDC) ice core, Antarctica. The graph shows CO₂ concentration (ppm) from 1800 to 2020. The concentration has risen from approximately 280 ppm in 1800 to over 410 ppm in 2020. The graph also shows the rate of change in CO₂ concentration, which has increased significantly since 1950.

The rate of greenhouse gases to global temperature cycles
From the air in our upper atmosphere, we can see that CO₂ has changed in a remarkably similar way to historic climate, with low concentrations during cold times and high concentrations during warm periods (see Fig. 16.16). This is a very consistent correlation between CO₂ and temperature, and each acts to amplify changes in the other. In fact, it is a positive feedback loop: the warming of the globe is amplified by the increase in CO₂, and the cooling of the globe is amplified by the decrease in CO₂. This is a very important concept to understand, as it shows how small changes in CO₂ can have a large impact on the climate.

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Fig. 16.17 The greenhouse effect. The diagram shows the sun's rays hitting the Earth's surface, which warms it. The Earth's surface then radiates heat back into the atmosphere. Greenhouse gases in the atmosphere trap some of this heat, warming the Earth's surface. This process is known as the greenhouse effect.

Fig. 16.18 The greenhouse effect. The diagram shows the sun's rays hitting the Earth's surface, which warms it. The Earth's surface then radiates heat back into the atmosphere. Greenhouse gases in the atmosphere trap some of this heat, warming the Earth's surface. This process is known as the greenhouse effect.

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MAJOR GREENHOUSE GASES

- Carbon dioxide (CO₂)
- Methane (CH₄)
- Nitrous oxide (N₂O)
- Fluorinated gases (F-gases)

Fig. 16.19 The greenhouse effect. The diagram shows the sun's rays hitting the Earth's surface, which warms it. The Earth's surface then radiates heat back into the atmosphere. Greenhouse gases in the atmosphere trap some of this heat, warming the Earth's surface. This process is known as the greenhouse effect.

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Water storage and trading

Fig. 16.20 Water storage and trading. The diagram shows water storage and trading in Australia. It includes a table with columns for 'Water storage', 'Water trading', and 'Water allocation'.

Water storage	Water trading	Water allocation
...

Learning activities

- Use the flow governmental arrangements chart to make a map.
- List the different industries that need water allocation.
- List the water allocation types that are purchased for agricultural use.
- List positive outcomes from water market trading for primary industry production.

Learning modules

Module 2: Australia's variable climate

Climate variability is a significant source of risk for farming businesses.

Climate risk management involves assessing the impact of climate variability, applying structural change and making both strategic and tactical decisions to minimise the risk (George et al 2005).

Climate risks

The agriculture sector is highly exposed to climate risks and in Australia, the variability of the weather and climate is one of the most difficult risks to manage (BoM n.d.).

Risk is most simply defined as a situation involving exposure to danger, harm or loss.

When we put this in the context of the risk to an agribusiness caused by climate it is the agribusiness's exposure to danger, harm or loss as a result of climate variability and/or climate extremes.

Most often we think of the risks to production but climate and weather can pose many more risks to on-farm management systems.

Production risks include crop loss, yield and pasture growth, and subsequent...

Module 3: Climate variability

"Climate is what you expect; the weather is what you get." - Unknown

Climate variability can be defined as 'natural changes in climate that fall within the normal range of extremes for a particular region, as measured by temperature, precipitation, and frequency of events'.

Variability of Annual rainfall

Country	Variability (%)
Australia	18
United States	14
Germany	12
France	10
UK	8
Canada	6
China	4
USA	2
Russia	1

Variability of rainfall for different countries. Source: Bureau of Meteorology

Phenomenon responsible for rainfall variability

Module 4: Managing processes in agricultural systems

Weather and climate risk

Climate variability has an enormous impact on agricultural production in Australia and is a major source of agricultural risk.

Introduction

Press play to listen to the audio

Effective management of the risks associated with climate variability in the agricultural sectors is the key to achieving sustainability.

This topic explores the principles of risk management and frames risk management in the context of production related climatic risk (short, medium or long term).

Module 1: Weather and climate

Introduction

The weather is a vital component in farming.

Press play to listen to the audio

Skills in using climate and weather information are crucial for every aspect of property management.

WEATHER **CLIMATE VARIABILITY** **CHANGING PATTERNS OF CLIMATE**



Module 5: Research into climate variability

This module identifies research into climate variability and related management strategies. Research is essential to Australia's food security now and into the future.

ACTIVITIES

1. Review the range of research papers from those provided in the NSW DPI Climate Challenge workbook and list at the bottom of the page to identify the following syllabus outcomes required in the Climate Challenge elective. These assist you in determining which example/s address the needs of your teaching program and students.
2. Syllabus outcomes: analyse a research study on climate variability or management strategies related to climate variability in terms of:
 - design of the study
 - methodology of the study
 - collection of data for the study
 - presentation of data
 - analysis of data
 - conclusions and recommendations
3. In this elective students are required to explain the need for research in climate variability or management strategies for climate variability. View the range of resources below and then develop your teaching strategy in your Climate Challenge workbook.

Why study climate?

- [State of the Climate 2018](#)



- [State of the Climate 2018: Behind the science - ocean temperatures and heat content](#)



- [State of the Climate 2018: Behind the science - climate extremes](#)



- [Factors often for climate change unlike the Adiant NSW coastal](#)



Approximate time to complete: 30 minutes

Resources:

- [Front of the future digital resources](#) - The NSW DPI Climate Smart Pilot project trials digital technologies that improve the information generated on natural resources and climate variability. Check out the range of digital resources.

Module 6: Create your own fully resourced teaching and learning unit program

This module allows you to focus on developing your own resourced teaching and learning unit and program.

Provided are the NSW DPI Climate Challenge student study guide and the Analyse a Research Study- sample papers document. They are aligned to cover all syllabus outcomes for the [NSW Agriculture Stage 6 syllabus, Elective 2: Climate Challenge](#).

Provided is a sample program for the elective written by NSW Education Authority (NESA) [HSC Agriculture - Unit of work - Elective 2: Climate Challenge](#).

ACTIVITIES

1. Take this time to modify the provided program or create your own to reflect your own teaching and learning plan. Make sure to link to any resources you plan to use throughout the unit, planned activities and assessments. NSW DPI Climate Challenge student workbook provided to get you started.

Resources:

- [PD CLIMATE CHALLENGE workbook.pdf](#)
- [NESA Sample unit for Climate Challenge-1.docx](#)
- [Analyse a Research Study- Climate Challenge papers](#)

- Climate Dogs- animations for teaching/understanding the drivers behind Australian weather

<https://youtu.be/xk9LkrTEpBc>

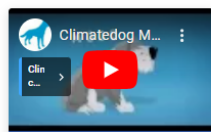
Climate influences on Australian weather

Published 8 March 2022



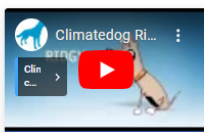
Meet the ClimateDogs

Understanding what influences Australia's climate at key farm decision making points throughout the year is crucial. The NSW ClimateDogs animation series uses sheep dogs to explain complex atmospheric phenomena. The series has been developed in collaboration with the Australian Bureau of Meteorology and Victorian Department of Primary Industries.



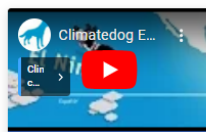
MOJO

Is the Madden Julian Oscillation of tropical systems near the equator, which can influence Australia's weather and climate, especially during the warmest months of the year.



RIDGY

Otherwise known as the Subtropical Ridge is the lead dog of the pack. RIDGY's position and intensity have a significant influence on weather in NSW. Recent changes in RIDGY's behaviour appear to be driving some significant changes to southern NSW rainfall patterns.



ENSO

Represents the El Niño Southern Oscillation. Changes in ENSO's behaviour has a significant influence on rainfall probabilities in inland NSW during the winter and spring period.



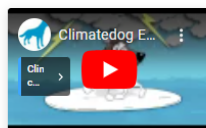
INDY

Represents the Indian Ocean Dipole. Like ENSO, changes in INDY's behaviour also has a significant



SAM

Represents the Southern Annular Mode and is a complex climate dog. Recent changes in SAM's



EASTIE

The East Coast Low phenomena represents the deep low pressure systems that are an important



Please reach out to for any inquiries to megs.dunford@dpi.nsw.gov.au

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