

**EDUCATION  
RESOURCE BOOKLET**



**ATMOSPHERIC**  
THE BURNING STORY OF CLIMATE CHANGE

**CAROLE  
WILKINSON**

Classroom ideas by  
**GREG REID**

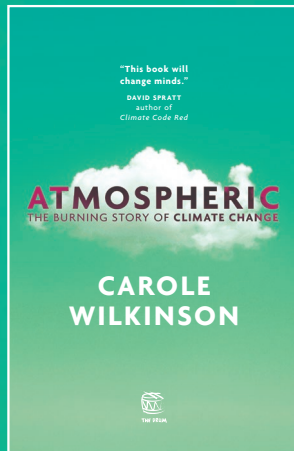


# ABOUT

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**ATMOSPHERIC**  
**9781925126372**  
**AU\$18.95/NZ\$21.99**  
**EBOOK AVAILABLE**

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Talking about the weather used to be small talk, now it's the hottest topic on earth. For billions of years our atmosphere has supported life on Earth, from primitive algae, to the human race. But something is happening. Slowly but surely, what we are doing to our atmosphere is changing Earth's climate. *Atmospheric* cuts through the many voices raised around climate change to tell the story of our atmosphere, what is putting our climate at risk and what we can do about it. This could be the most important book you read in your life.

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## ABOUT CAROLE WILKINSON

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**CAROLE WILKINSON** is an internationally award-winning and much loved author of books for children. She has won both literary and children's choice awards. Carole is interested in the history of everything and is passionate about the issues surrounding climate change.



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### THE DRUM SERIES

This award-winning history series uses first-person accounts and non-fiction to bring history roaring to life. Perfect for use with lower and mid-secondary history classes.



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### BLACK DOG BOOKS

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In 2009, I had been waiting for two years for the federal government to fulfil its election promise to come to terms with climate change. By that time it was pretty clear what they were going to do – nothing. I strongly believed that climate change was the most important issue of our time, but all I had done up to that point was shout at politicians on the television, which was equivalent to doing nothing. I decided it was time I did something. So I joined my local climate action group.

Over the last six years I have written submissions to three levels of government. I have attended rallies and protests on the steps of the Victorian parliament. I have chalked messages on the footpath outside politicians' offices. I have read a lot about the science behind climate change and I have tried to convince others that it is essential for individuals, businesses, towns and countries to change the way they live in order to reduce the amount of greenhouse gas emissions we all produce.

Black Dog Books publisher and friend Maryann Ballantyne knew about my climate activism, and it was she who suggested I write a book on climate change. I didn't hesitate. I said yes. I had studied science subjects at school and worked in laboratories for the first 15 years of my working life. That time had always seemed completely disconnected from my later life as an author. For the first time since I started writing, my scientific background looked like being useful. I am not intimidated by science. I hoped that would help me communicate the scientific evidence to support climate change to my young readers.

Climate change is a huge topic. As with my previous books, I had to tell a story, one that would engage my readers. Except this particular story could well turn out to be the most important in human history. No pressure!

I attended a climate change panel where the panelists discussed how scientists are often not good at interpreting climate science in a way that can be understood by the general populous. They said it was necessary to translate the science to make it available to new audiences. They emphasised how important it was to stand up for science. That panel session helped crystalise my approach to the book. I knew what I had to do – I had to stand up for climate science and translate it in a way that young people would understand.

**CAROLE WILKINSON** author of *Atmospheric*

Who better to write a book dealing with the complex issues of climate change than Carole Wilkinson? In the voices raised around climate change I knew Carole's meticulous research and common sense style would be the perfect way to give context to issues that are sometimes difficult to understand.

But even knowing what I know about Carole's writing, *Atmospheric* took me by surprise. Carole has chosen to tell the story of our atmosphere - something that links us all. Through history, Carole details the small pieces of information that have come together over hundreds of years to make up the picture that we have of our atmosphere. It is a beautiful discussion of the meeting between science and history. It is the story of the environmental consequences of the choices we make, both negative and positive. But what inspires me most about *Atmospheric* is the stories Carole tells of people - some of them ordinary people like the Marsham family who over centuries made and recorded observations of the changing of the seasons on their family farm, data that has been used by modern day climate scientists. And other people who were observant of change, everyone from ordinary people who were committed to the environment to scientists making remarkable links.

For me, *Atmospheric* by Carole Wilkinson is a timely reminder that everyone in the community has the capacity to influence the environment. I am proud to publish it in the Black Dog Books list.

**MARYANN BALLANTYNE** publisher of *Atmospheric*

# AUSTRALIAN CURRICULUM OVERVIEW

		YEAR 7	YEAR 8	YEAR 9	YEAR 10
<b>ENGLISH</b>					
<b>Language</b>	Text structure and organisation	ACELA1531 ACELA1763	ACELA1543 ACELA1766 ACELA1809	ACELA1553	ACELA1568
	Expressing and developing ideas	ACELA1537	ACELA1545 CELA1548	ACELA1557	ACELA1569 ACELA1570 ACELA1572
<b>Literature</b>	Literature and context	ACELT1619	ACELT1626	ACELT1633	ACELT1639
	Responding to literature	ACELT1620 ACELT1621	ACELT1807	ACELT1635	ACELT1641 ACELT1812
	Examining literature	ACELT1622	ACELT1629	ACELT1636 ACELT1772	ACELT1643 ACELT1774
<b>Literacy</b>	Interpreting, analysing, evaluating	ACELY1721 ACELY1722 ACELY1723	ACELY1732 ACELY1733 ACELY1733 ACELY1734	ACELY1742 ACELY1743 ACELY1744 ACELY1745	ACELY1752 ACELY1754
<b>GEOGRAPHY</b>					
<b>Geographical knowledge and understanding</b>		ACHGK037 ACHGK042 ACHGK045	ACHGK059	ACHGK061 ACHGK063	ACHGK070 ACHGK073 ACHGK074 ACHGK075
<b>Geographical inquiry and skills</b>	Collecting, recording, evaluating and representing	ACHGS049	ACHGS057	ACHGS065 ACHGS066	ACHGS074
	Interpreting, analysing and concluding	ACHGS051 ACHGS052	ACHGS059 ACHGS060	ACHGS067 ACHGS068	ACHGS076 ACHGS077
	Communicating	ACHGS053	ACHGS06	ACHGS070	ACHGS079
<b>SCIENCE</b>					
<b>Science understanding</b>	Earth and space sciences	ACSSU116 ACSSU222	ACSSU153	ACSSU180	ACSSU189 ACSSU189
<b>Science as a human endeavour</b>	Nature and development of science	ACSHE119 ACSHE223	ACSHE134 ACSHE226	ACSHE157 ACSHE158	ACSHE191 ACSHE192
	Use and influence of science	ACSHE120 ACSHE121 ACSHE224	ACSHE135 ACSHE136	ACSHE160 ACSHE161 ACSHE228	ACSHE194 ACSHE195 ACSHE230
<b>Science inquiry skills</b>	Processing and analysing data and information	AC SIS129 AC SIS130	AC SIS144 AC SIS144	AC SIS169 AC SIS170	AC SIS203 AC SIS204
	Evaluating	AC SIS132	AC SIS234	AC SIS171 AC SIS172	AC SIS206
	Communicating	AC SIS133	AC SIS148	AC SIS174	AC SIS208

\* Key content descriptors have been identified from the Australian Curriculum. However, this is not an exhaustive list of Australian Curriculum content able to be addressed through studying this text.

# CLASSROOM IDEAS

## Before Reading

What is your understanding of climate change? Write several paragraphs about whether you believe climate change is an actual phenomenon, what you believe are the causes and if anything can be done to slow, stop or reverse it. Revisit your answer to this question after reading Atmospheric to compare it to what you have learned from the book.

## Narrative extracts before each chapter

- Give reasons why you think Carole Wilkinson has chosen to insert narrative extracts before each chapter.
- How effective do you think these extracts are in achieving the author's purpose?
- Comment on the gender and ages of the people who have "written" the narratives. Suggest why the author has chosen the specific people for the extracts.
- Choose one narrative and explain why the character appeals to you.

## Character spotlights

- What is the purpose of this structural feature of the text?
- Why have these features been set out in a different way to the rest of the text?
- Choose one character spotlight and explain the significance of this person to our knowledge of climate change.

*Through greed, we have established an economy that destroys the web of life. We have changed our climate and drown in despair. Let oceans of justice flow. May we learn to sustain and renew the life of our Mother Earth.*

Archbishop Desmond Tutu, prayer for the People's Climate March, September 2014.

What does this quotation reveal about the perspective of the author?

## Introduction

Briefly outline the author's reasons for writing this book.

Page #

9

## Chapter 1 – A Narrow Band of Blue

Explain how the greenhouse effect works. Why is this essential for life on Earth?

18

What is global warming and which gas is largely responsible?

20

Comment on the importance of CO<sub>2</sub> to global warming.

20

Make a list of greenhouse gases other than CO<sub>2</sub>

22

How are other greenhouse gases measured?

24

Using the table of greenhouse gases in Earth's atmosphere, elaborate on how the "main human sources" listed contribute to the production of each greenhouse gas.

26

## Chapter 2 – Buried Deep

What are fossil fuels and why are they so named?

32

Briefly explain how oil forms.

36

In what way does the formation of natural gas differ from that of oil?

37

## Chapter 3 – Seeds of Knowledge

What was the significance of Ruddiman's 2001 hypothesis?

45

How does deforestation effect climate change?

47

Complete the below table of ancient beliefs about climate change. Research other ancient cultures or scholars not mentioned in the book to discover their beliefs about weather and climate change.

51

Ancient Society	Beliefs
Ancient Chinese	
Norse	
Hindu	
Ancient Egyptian	
Ancient Greek	
Ancient Roman	
Christian	

# ATMOSPHERIC

	Page #		Page #
How did erratics challenge the belief at the time that the overall climate of the world was stable?	55	Outline the role Octavia Hill played in addressing air pollution.	99
<b>Chapter 4 – Heat and Ice</b>		Describe the origins of the <i>Clean Air Act</i> of 1956.	102
What contributions did Joseph Fourier and John Tyndall make to the study of climate?	64	How did the <i>Clean Air Act</i> change air quality in London?	
Explain the significance of Louis Agassiz and James Croll’s theories about ice ages. Suggest why the ideas of both these people were controversial at the time.	67	<b>Chapter 7 – Black Gold and Tin Lizzies</b>	
What role did Svante Arrhenius play in our understanding of climate change?	69	What is black gold? Why is it called this? Briefly describe how it has been used through history.	107
<b>Chapter 5 – Chimneys and Machines</b>		What significance did the invention of the electric light globe and the automobile have on oil production?	108
Comment on the importance of steam and coal to the Industrial Revolution. Why was James Watt’s invention critical to the Industrial Revolution?	77	Why has the author used the heading "Cars to the rescue"?	109
Why is Richard Arkwright known as the “ <i>father of the modern industrial factory system</i> ”?	82	Describe the role Bertha Benz played in the development of the car.	111
What helped spread the Industrial Revolution from Britain to the rest of the world?	83	What is OPEC? Why is OPEC significant? Why was coal still required as the twentieth century progressed?	112
What modern conveniences were developed in the Industrial Revolution?	83	How was the problem of engine “knock” solved? What problems did this solution create?	113
What were some of the costs of the Industrial Revolution?	85	Why did General Motors keep the knowledge secret that lead was dangerous to people’s health?	114
<b>Chapter 6 – The Big Smoke</b>		List the dangerous waste products that cars produce.	115
List the dangers the people of Victorian England experienced by living amongst the output of the new factories, furnaces and fireplaces. Describe the argument that industrialists used to justify air pollution.	91	What is photochemical smog and what impact does it have on human health and the environment?	116
Why is John Evelyn a significant figure in the history of climate change?	93	Explain what the sub-heading "Cleaning up" means in relation to air pollution by cars.	117
Why was the 1853 <i>Smoke Nuisance Act</i> enacted? What did the Smoke Nuisance Act try to do and why was it unsuccessful?	97	Comment on the role of industrialists in London and Los Angeles.	
How did Rollo Russell’s <i>London Fogs</i> contradict the views of factory owners and doctors?	98		

# CLASSROOM IDEAS

Using the information in Chapter 7, complete the below table to compare and contrast the experiences of London and Los Angeles in relation to smog.

	Problems	Solutions
<b>London</b>		
<b>Los Angeles</b>		

## Chapter 8 – Solid Science

How did Milutin Milankovic explain ice ages on Earth?

What theory did Guy Stewart Callendar propose? How did meteorologists receive his theory?

Describe Charles Keeling's contribution to the understanding of Earth's climate.

What bold prediction did Bert Bolin make in 1959?

What are climate proxies?

Complete the below table listing climate proxies by briefly describing how each records meteorological events.

Climate Proxy	How Meteorological Events are Recorded
<b>Trees</b>	
<b>Coral</b>	
<b>Stalactites/stalagmites</b>	
<b>Pollen</b>	
<b>Ice cores</b>	
<b>Lake sediments</b>	
<b>Deep sea sediments</b>	

What are ice cores and which areas provide them?

What "secrets" are contained in ice cores? What are isotopes of oxygen? Why are they important?

Page #

Page #

Explain how scientists are able to construct ancient climates using forams.

134

Why are ocean sediment cores more compressed than ice cores?

134

Use the information in the table to draw a column graph of the age limits of climate proxies. Comment on the availability of the various climate proxies.

135

How were Milankovic's calculations of ice ages finally verified?

135

## Chapter 9 – Fixing a Hole

What is ozone? How does ozone form? How does ozone damage human health and protect life on Earth?

141

Why has Thomas Midgley Jr "had more impact on the atmosphere than any other organism in Earth's history"?

142

What are CFCs and what feature do they have that makes them useful in manufacturing? What applications did CFCs have?

144

Why did Molina and Rowland win the Nobel Prize for Chemistry in 1995?

146

Contrast the attitude of CFC manufacturers with that of environmental and consumer groups.

147

What did Joseph Farman and the BAS team discover about the ozone layer?

149

Describe the ozone hole. Why is the word "hole" inaccurate?

150

Outline the timeline of events to stop ozone depletion.

150

What is the Montreal Protocol? Why is it significant?

151

Suggest strategies to stop the illegal manufacture of ozone depleting substances.

153

123

125

126

127

128

128

130

132

# ATMOSPHERIC

<b>Chapter 10 – Hotting Up</b>	<b>Page #</b>		<b>Page #</b>
Why did knowledge of Earth’s climate begin to accelerate in the 1980s?	158	What was the Kyoto Protocol? Explain the response of Australia and the United States to the Kyoto Protocol.	175
Explain the significance of the <i>New York Times</i> article by NASA scientists led by Dr James Hansen.	158	Briefly describe how climate deniers presented their case. What was the rationale behind the climate deniers’ arguments?	178
How did the NASA measurements and those of the British scientists complement each other?	158	Comment on Frederick Seitz’s role in denying the harmful effects of smoking and global warming.	178
What was Veerabhadran Ramanathan’s shocking discovery in 1975?	160	What is the Keeling Curve? What does it show?	178
What was the significance of Ramanathan’s discovery about the other greenhouse gases?	160	Suggest reasons for the collapse of the Global Climate Coalition in 2000.	180
What are synthetic greenhouse gases and what is their global warming potential?	161	What is a carbon footprint? Why is the concept of carbon footprints a useful one?	180
Why were CFCs added to the Montreal Protocol?	161	Why did grassroots climate action groups form in the early 2000s?	180
What is methane? Where does methane come from? Why have methane levels risen rapidly in recent times?	162	What is the AYCC and what does it do?	182
Explain the significance of nitrous oxide from human sources to global warming.	163	What are the consequences of the current world addiction to oil?	185
Why has the accuracy of forecasting increased significantly since the 1950s?	165	How are plastics made? What are the negative impacts of plastics on the environment?	186
Describe two ways that CO <sub>2</sub> levels can be measured over time.	167	Why has the author used the heading “Turnaround” for the information on DuPont?	187
Why does the author describe the title of the 1985 climate conference as “clumsy”?	168	Give reasons for the current severe pollution in China and India.	188
What did the report that Bert Bolin compiled predict about climate change?	168	What is the phenomenon known as ABC? Describe the impacts of ABC on human health and the environment.	189
What urgent action did climate scientists call for?	169	Research the effectiveness of Project Surya on reducing black carbon in the atmosphere.	190
What is the IPCC and what is its role?	169		
<b>Chapter 11 – Action</b>		<b>Chapter 12 – Running on Empty</b>	
What was Ramanathan’s response to the African student? How did this affect his future work?	174	What does this story reveal about Søren Hermansen and Torben Tranberg’s father?	192
What is the Global Climate Coalition and what is its aim?	174	Describe the predicted supplies of the main fossil fuels.	196



# CLASSROOM IDEAS

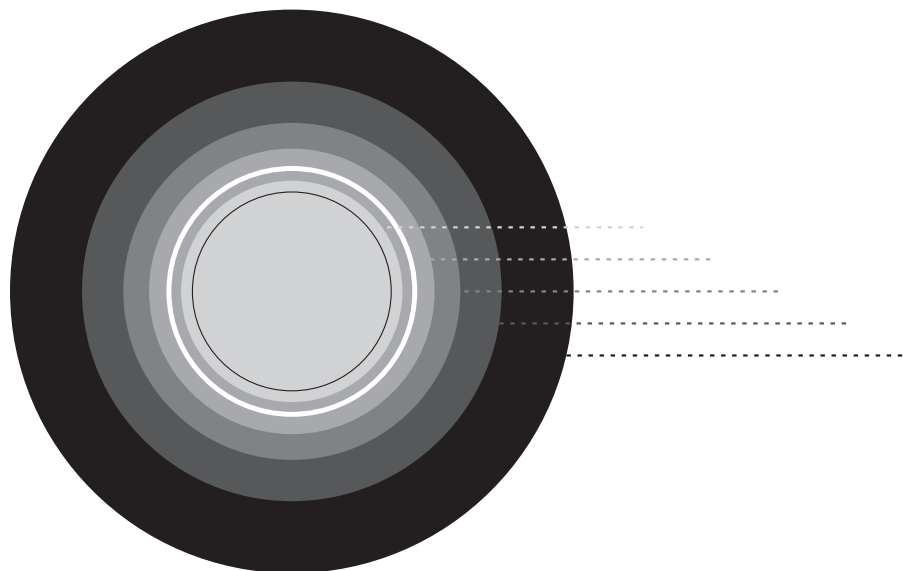
	<b>Page #</b>	
What are unconventional fossil fuels? Why are unconventional fossil fuels expensive and polluting?	197	As you read the book, keep a list of any unfamiliar words. Research the definition of these words and create your own extended glossary for <i>Atmospheric</i> .
List sources of renewable energy.	201	In small groups, brainstorm a future that is 4 degrees warmer than current average temperatures. What would this mean? Find reliable sources to base your predictions on. How would this change in temperature affect rural communities and urban communities? Present your finding to the class.
Suggest reasons why the international oil industry is reluctant to diversify and start investing in renewable energy.	204	
Discuss why Australia established and then abolished a carbon tax.	206	Imagine a future where renewable energy is dominant, rather than fossil fuel energy. How would this affect your daily life? What other effects would this have on society?
Suggest reasons why the Australian federal Government is reluctant to abandon coal-fired power plants and encourage the use of renewable energy.	206	Hold a series of debates on the following subjects: <ul style="list-style-type: none"> <li>• Climate change is a myth</li> <li>• It is too late to combat climate change</li> <li>• The benefits of using fossil fuel outweigh the damage to the environment</li> <li>• One person cannot make a difference</li> </ul>
Comment on how future generations are likely to view Tony Abbott’s quotation on coal.	207	
What amazing thing happened between 2006 and 2013 in Australia?	207	
Distinguish between natural and man-made “forcings” on Earth’s climate.	208	
Explain how climate feedbacks can influence climate.	209	
Why are climate processes hard to stop once they are set in motion?	209	
<b>Chapter 13 – People Power</b>		
What specific actions has Vincent Dwyer taken to reduce his family’s carbon footprint?	214	
How does the author suggest that readers verify if websites are trustworthy?	219	
What recommendations does the author make to save electricity and gas?	219	
Explain how the concept “refuse, re-use, recycle” can reduce carbon footprints.	220	
Why shouldn’t we waste food?	224	
<b>Extra activities</b>		
Choose one person from the timeline (page 234-235) and write a report on why they have been included as a significant figure in this book.		
		<b>USEFUL RESOURCES:</b>
		<b>AUSTRALIAN GOVERNMENT DEPARTMENT OF THE ENVIRONMENT: CLIMATE CHANGE</b> <a href="http://www.environment.gov.au/climate-change">http://www.environment.gov.au/climate-change</a>
		<b>AUSTRALIAN GOVERNMENT DEPARTMENT OF THE ENVIRONMENT: CLIMATE CHANGE IMPACTS ON YOUR STATE</b> <a href="http://www.environment.gov.au/climate-change/climate-science/impacts">http://www.environment.gov.au/climate-change/climate-science/impacts</a>
		<b>CLIMATE CHANGE IN AUSTRALIA</b> <a href="http://www.climatechangeinaustralia.gov.au/en/">http://www.climatechangeinaustralia.gov.au/en/</a>
		<b>WORLD WILDLIFE FOUNDATION: CLIMATE CHANGE</b> <a href="http://www.wwf.org.au/our_work/people_and_the_environment/global_warming_and_climate_change/">http://www.wwf.org.au/our_work/people_and_the_environment/global_warming_and_climate_change/</a>
		<b>Q&amp;A: CLIMATE DEBATE</b> <a href="http://www.abc.net.au/tv/qanda/txt/s3487316.htm">http://www.abc.net.au/tv/qanda/txt/s3487316.htm</a>
		<b>THE CLIMATE REALITY PROJECT AUSTRALIA: EDUCATION RESOURCES</b> <a href="http://www.climateReality.org.au/education.html">http://www.climateReality.org.au/education.html</a>
		<b>NSW GOVERNMENT OFFICE OF ENVIRONMENT &amp; HERITAGE: CLIMATE CHANGE RESOURCES</b> <a href="http://www.environment.nsw.gov.au/sustainableschools/teach/climatechange.htm">http://www.environment.nsw.gov.au/sustainableschools/teach/climatechange.htm</a>

# ATMOSPHERIC

## WORKSHEET Layers of the Atmosphere

#1 Fill in the names of the layers of the atmosphere in the below diagram.

—



## WORKSHEET Excuses, Excuses, Excuses

#2 Complete the following table of arguments to combat climate change action excuses. Add other excuses and arguments not mentioned in the book. Refer to pages 210 - 213.

—

EXCUSE	ARGUMENT
Australia's emissions are insignificant	
My emissions are insignificant	
Plenty of people think climate change doesn't exist	
Someone in the future will fix it	

## WORKSHEET My Action Plan

**#1** Use this action plan worksheet to make a list of changes you can make to reduce your carbon footprint.

**NAME**

**DATE**

**AREA**

**MY ACTION**

**Electronics**

- e.g. Turn TV off at the wall

**Transport**

**Food**

**Recycling**

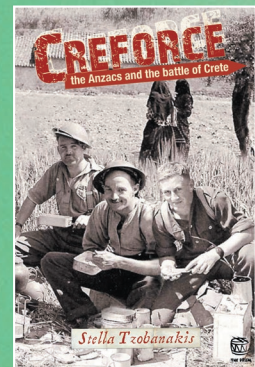
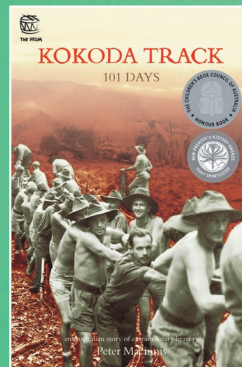
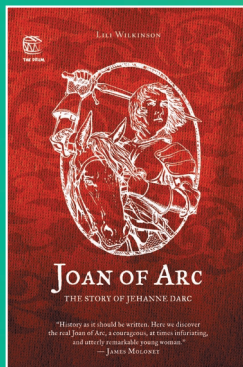
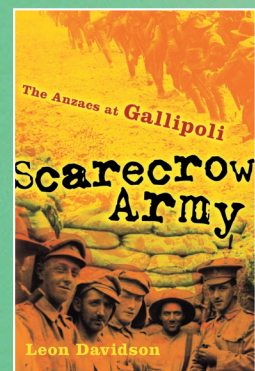
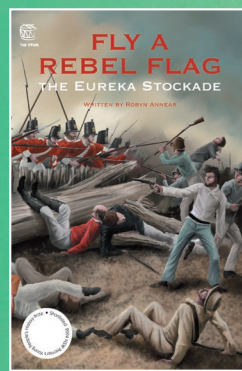
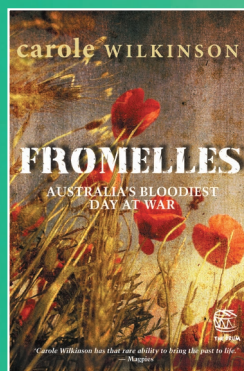
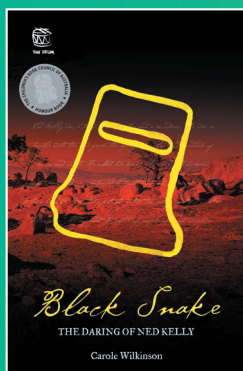
**Washing/Cleaning**

**Community engagement (political/social)**

# THE DRUM SERIES



This award-winning history series uses first-person accounts and non-fiction to bring history roaring to life. Perfect for use with lower and mid-secondary history classes.



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