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by Dr John Long

The Big Picture Book of Environments

by Dr John Long,

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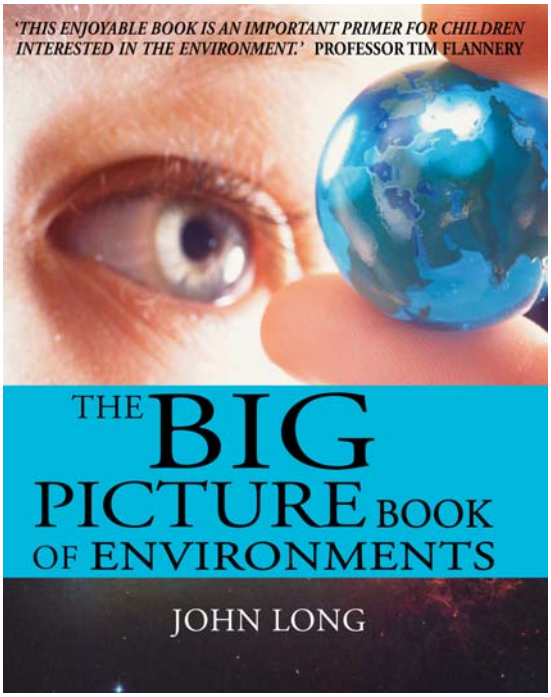

83 Alexander Street
Crows Nest, Sydney
NSW 2065
Australia

PO Box 8500
St Leonards
NSW 1590
Australia

ph: (61 2) 8425 0100
fax: (61 2) 9906 2218

info@**allen**and**unwin**.com
www.**allen**and**unwin**.com

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INTRODUCTION

THE VALUES AND BELIEFS BEHIND THIS BOOK

I think this is one of the most important book projects I've ever undertaken. I feel passionately about our environment and am deeply concerned about the current global warming crisis, but I wanted to get this message across in a way that would not intimidate young children. I hope that they, the next generation to vote, will read this book and take home a strong message to care for our planet and preserve its vulnerable ecosystems for the future.

I began by taking photos at every opportunity to capture different environmental settings, including shots of a diminishing glacier in New Zealand whilst on my honeymoon in 2006. I wrote the text drawing on the latest scientific articles and updated it in proof to make sure the information was as current as possible.

The book shows that the world is made up of many environments, each with its own amazing fauna, flora and climate, and each with its own special vulnerabilities. Global warming at the predicted scale will have severe detrimental effects on many of these environments, and unless we act now irreversible damage will occur to some of them well before the end of this century.

This book is the middle one of a set of three:

- *The Big Picture Book*, published in 2006, described Earth's history and the evolution of life in geological time;
- *The Big Picture Book of Environments* describes the history of Earth's climate and atmosphere and the effects of global warming on the many environments of our planet;
- The forthcoming *The Big Picture Book of Human Civilisations*, to be published in 2009, sweeps through human history from 20 000 years ago to today and even into the future.

The Big Picture Book won a Wilderness Society award and an award for Excellence in Educational Publishing, and was shortlisted for both the WA Premier's and the Children's Book Council of Australia (Eve Pownall) awards.

I believe the outstanding features of the book are the beautiful images, clear diagrams explaining how climate systems work, simple but clear text and future scenarios projected at the end of the book. It's a book written for any country; it is universal in appeal. I hope students and teachers who use it in their classrooms find it so.

Note: The book is printed on FSC paper, and carbon emissions associated with its production have been neutralised through Climate Friendly*.*

SUMMARY

This book was written for upper primary and lower secondary level students, to give an understanding of the current state of the natural environment around the world, and to show how human activities affect the many different ecosystems of the Earth through loss of habitat, emission of greenhouse gases into the atmosphere, and rapid population growth.

In three sections, 'Earth Past', 'Earth Present' and 'Earth Future', the book shows how the planet started and how climate has changed over past millennia; what varied environments have resulted and some of their most notable animals and plants; and how they are affected by the man-made climate change that we can observe now. The environments range from tropical rainforests to tundras, deserts to polar regions, abyssal depths to cities, and more. The two final spreads sketch two different pictures of life in 2080: Earth as it might be if we do nothing to slow climate change,

and as it might be if we do act decisively. The aim is to be positive and empower young children of today to act as carers of the world's biomes in the future.

Based on the latest scientific articles, and packed with photos of places and animals, clear explanations of concepts and carefully chosen statistics, this book gives a view of Earth's many environments through a wide-angle lens. It celebrates the richness of life on Earth, while giving a sober scientific assessment of the risks we run if we continue our present heedless lifestyle.

The **big ideas** embedded in the book are:

1 geological time (from 20 000 years ago to the near future);

2 the physical processes involved in the formation of the Earth, its seas and atmosphere, and in the operation of climate;

3 the biological communities (called biomes) that exist because of vegetation and weather regimes; and

4 the impact of human-induced global warming and the need for action to keep our planet habitable.

Hence the book is largely about science but also dwells on the need for social responsibility.

PRE-READING – CONCEPTS & SKILLS

The language used in *The Big Picture Book of Environments* has been kept as simple as possible, but there are some fundamental concepts that students will need to understand if they are to make best use of the book. Some of these concepts will develop along the way if your students read carefully and you allow plenty of time for discussion, but it would certainly be helpful to clarify what the children know about **gases and liquids**, **atoms and molecules**, **the water cycle**, **averages** and **percentages** before you begin, and 'top up' if necessary, as the text presumes an understanding of these ideas.

It could also be helpful to read some of the book, especially Part I, as a whole class, to make sure students understand the key terms.

Finally, it is important for students to notice how the book is structured in three parts.

CONCEPTS

- Time – in particular, deep geological time; measurements of time
- Earth's atmosphere and ocean – measurement of their height/depth
- Gases and behaviour of gases, especially carbon dioxide
- Climate zones
- Winds and air pressure
- Ocean currents
- Natural cycles: global warming & cooling; water cycle
- Averages and percentages

Note: The basic concepts of geological time, astronomy, evolution and how new species arise in nature are explained more fully in the Teachers Notes to the first book in this series, *The Big Picture Book*. Please refer to these (from the Allen & Unwin website) if you need further information about these topics.

http://www.allenandunwin.com/_uploads/BookPdf/TeachersNotes/9781741143287.pdf

SKILLS REQUIRED AND DEVELOPED

The book could help to develop **visual and statistical literacy** through, for example:

- the diagrams of the atmosphere and the ocean depths;
- the global warming graph on page 12 (NB note that graph does not start from zero);
- the carbon cycle diagram on page 17;
- the biome maps (how important is distance from the equator, size of land mass, influence of oceans or local mountains in determining climate? – guesses could be made here);
- statistical information in Fact Boxes about proportions of gases in the air, comparative temperatures, heights, depths and volumes;
- interpretation of photographs (NB the absence of labels for many of the photographs is deliberate, to allow exploration and discovery by the children, stimulating discussion and possibly further research to find answers).

RELEVANT CURRICULUM STRANDS

The most relevant units to the current curriculum *in The Big Picture Book of Environments* are Science and Study of Society.

SCIENCE

The Environment

All organisms exist within ecosystems and have attributes that assist their survival, and different regions - *biomes* - have distinct fauna, flora and climate, or if under water will have a depth and temperature zone. Examples of living things with special structures that help them survive are the woodpecker (p21) shown here digging into a tree to find grubs, or the camels (p26) which have humps for storing water on their backs - useful in the desert environment. Some animals are quite specialised and differ from their cousins living elsewhere, e.g. the tree kangaroo (p19) eats leaves from trees whereas normal kangaroos mostly eat grasses and shrubs close to the ground, and the panda (p25) is a bear adapted to a diet of bamboo, quite unlike all other bears which are omnivores that eat a wide range of animal and plant foods.

Climate and the Environment – greenhouse gases

The book gives an introduction to the main features of the Earth's atmosphere (pp16-17) and how the **carbon cycle** works. This is a very important point to understand. Carbon is constantly being transferred between the atmosphere and the geosphere or solid Earth, being locked up as chemicals in limestone rocks or being trapped in ocean-floor sediments. Every time an animal or plant dies and decomposes, the process breaks down complex molecules and releases carbon dioxide. Carbon dioxide, or CO_2, dissolves into cold waters and precipitates in calcium-saturated zones of the ocean as calcium carbonate ($CaCO_3$). This forms limestone rock on the sea floor, or can be precipitated through living organisms in their shells (e.g. clams, marine snails, or corals).

Another major source of carbon dioxide and other greenhouse gases is volcanic eruptions, although these are now known from measurements of changing CO_2 from ice cores to be only a minor component of the overall contribution compared to man-made greenhouse gases. If they had been a prime driver in changing climate we would see the effects of recent mega-eruptions such as Krakatoa (1883) or the greatest Asian eruption of the past million years, Toba (74 000 years ago); yet, despite good and continuous records in the Antarctic ice cores, no such dramatic climate swings have occurred.

Some people think global warming is due to variances in sunspot or solar-flare activity and not from human activity using fossil fuels. The weight of evidence is against this, as seen in recently published scientific journals of high repute (e.g. see M. Lockwood & C. Frohlich, Proceedings of the Royal Society of London, series A doi:10.1098/rspa.2007.1880). Such studies show that all trends in solar activity over the past 20 years that might have affected Earth's climate one way or another have not been correlated with actual climatic effects.

It has been shown that atmospheric composition is far more important in determining the surface temperature of a planet, rather than the distance to the sun. The best example to show the role of CO_2 in regulating planetary climate is to compare the surface temperatures of Mercury and Venus. Mercury is closest to the sun with 3.6 per cent CO_2 and 3.4 per cent water vapour in its atmosphere, but surface temperatures are as cold as –180°C and as hot as 430°C in places, averaging around 100°C. Venus is much further away from the sun but has an atmosphere of 96.5 per cent CO_2, and this creates a terribly hot greenhouse climate with average surface temperatures of around 460°C.

Other greenhouse gases play a significant role in increasing the Earth's warming, the greatest being **water vapour**, although its concentration fluctuates a great deal and it moves rapidly within the atmosphere.

Methane, a gas emitted by living organisms through respiration is far more potent than carbon dioxide – possibly more than 20 times as potent – in causing warming but is at the moment present in far smaller quantities and doesn't remain within the atmosphere as long as CO_2 does.

Annually, Australian livestock produce about 3 million tonnes (Mt) of methane, which has an equivalent greenhouse effect similar to 63 Mt of CO_2. Compare this with all of Australia's passenger cars which produce about 43 Mt of CO_2. The effects of the methane are clearly of major concern. Reducing our methane production by eating less meat derived from cows and sheep would be major contributor to lower our overall greenhouse emissions. For a good summary of this problem see Barry Brook and Geoff Russell's article 'Meat's Carbon Hoofprint' from *Australasian Science* (Nov/Dec 2007 pp 37-9). Incidentally, kangaroos' digestive system is quite different from that of cows and sheep, so they don't produce methane. If we ate more kangaroo in our diets we would not be contributing to the greenhouse emissions.

How do we know that humans are the main cause of greenhouse gases rising in the atmosphere?

The ice cores found in Antarctica provide a permanent record of atmospheric CO_2 levels continuously back for nearly 700 000 years, as told by inclusions of air bubbles trapped within the ice cores that scientists can analyse for CO_2 content. Not once over the past 700 000 years have CO_2 levels risen above about 250 parts per million except in the past 50 years and they are now rising steadily and fast (current level is about 380 ppm). This takes into account the past 7 ice ages where climates have shifted dramatically, and a large number of major eruptions from many of the world's biggest volcanoes (for actual volumes to compare the extent see Ian Plimer, *A Short History of Planet Earth*, ABC Books 2001, pp179, 198-9). The graph shown on p12 of the book is the Keeling curve; it's a convincing warning of how real global warming is. More details can be found about the history of the Keeling Curve in Al *Gore's An Inconvenient Truth* (Bloomsbury, 2006) or from Wikipedia.

Relationships of Living Things

Animals competing for resources in the same biome (specifically in Africa) are shown on pp24-5. This emphasises the interconnectedness of all animals and plants in their search for food (the lion on p24 is the predator in this system).

Interdependence of species is shown in the Fact Box on p31 ('Interesting Fact'), showing how the entire food chain in Antarctica is dependent upon krill; the general text on p30 explains how most life forms in Antarctica are seasonally dependent upon this resource. Studies by the British Antarctic Survey back in the late 1990s identified that diminishing sea ice in Antarctica results in lower krill biomass, as krill feed on algae and bacteria growing on the sea-ice. This in turn affects everything down the food chain from squid to fish, penguins, seals and whales.

An additional fact is that krill populations are directly related each year to the size of the Antarctic sea-ice shelf as they feed on bacteria that grows under the ice shelf. In years when the ice shelf is small (due to higher temperatures), there is a decrease of biomass of all life that depends on the krill right down the entire food chain (i.e. fewer fish, penguins, squid, whales, etc.). Although this food chain is largely centred in the southern oceans, it would affect neighbouring food chains in temperate latitudes which overlap with the migration of whales and fish from the colder southern waters. In effect, the overall size of the biomass of Antarctica effects all of us one way or another.

STUDY OF SOCIETY, SOCIETY AND ENVIRONMENT, OR CULTURAL STUDIES

Possible effects of climate change on economy, social organisation, politics

Predicting and preparing for the future

Effecting change

Taking action at school and at home

What will be the effect of climate change on our community? How will it effect peoples around the world? Can we alter the outcome?

The last part of the book provides two scenarios, one bad and one good, the difference being dependent upon the action we take now to make changes. This provides the basis for discussions about people in different places being more or less susceptible to the effects of global warming – for example, in lowland areas that are densely populated, such as Bangladesh, people will be the most at risk.

The big issue here is how to effect change – how do we make people aware of living an energy-hungry lifestyle that is damaging the future of the world? In the book the approach adopted is a positive one that every child can participate in by becoming aware of the amounts of energy we use in our daily lives, and taking measures to counteract them.

ACTIVITIES & DISCUSSION

PART I EARTH'S PAST

pages 6-7 Find out how much students already know about the gases nitrogen, oxygen and carbon dioxide. Can water be a gas? What is water vapour?(steam by another name)

Follow-up: After reading the box on atoms and molecules some students might like to find out formulae for other common gases and compounds, especially if they have scientifically-inclined parents or older siblings.

pages 8-9 Discuss the idea of a greenhouse world and greenhouse gases. Have any students been in a tropical country or somewhere in northern Australia that is hot and humid like a greenhouse? Have they been in a greenhouse? (If unavailable at botanical gardens, try the Butterfly House at a zoo.)

Find out whether students understand the idea of average temperature – explain with simple figures if not. Are they clear about Southern and Northern Hemispheres?

Research: Students could find out the average temperature for Darwin, and the average temperature of Hobart. Does an average increase of 20 degrees Celsius sound like a lot now?

Are students surprised to find out that we need a certain proportion of greenhouse gases? – that life would not exist without them? (See Interesting Fact box on p9.)

pages 10-11 Discuss the effect of ice formation on sea levels.

Dictionary: Make a class Environment Dictionary of key terms – greenhouse gases, albedo effect, megafauna - and keep adding to it as you go through the book. It could be done large-scale, as a poster, or as embedded formatting in electronic presentations.

page 12 Previous pages have already shown hot Earth and cold Earth. This page shows this has happened many times in the planet's history. And it connects recent warming with greenhouse gas emissions, especially carbon dioxide. Talk students through the graph (noticing that if the timeline extended back before 1958, the curve would not be so steep and alarming).

Carbon list: The class could begin a list of human activities that add to carbon dioxide production, and methane production. They could begin to imagine social changes that might reduce our 'carbon footprint'.

PART II EARTH PRESENT

pages 14-15 Students could discuss plants or animals they have studied in the past, and their habitats. What might be the difference between habitat and biome?

Dictionary search: Students could find out other words that start with 'bio' and what the root word is.

pages 16-17 It is worth spending some time on the carbon cycle. Why does burning fossil fuels or making concrete produce carbon dioxide?

Pages18-40 Students could read these pages individually, or in pairs for the following activities.

Oral report: Students can choose one biome and report back to the class what they have discovered about their chosen biome - what kind of climate it has and what kind of landscape and flora and fauna result, and what are the special risks to this biome from global warming.

Further Research: Ask students to find out more about their chosen biome from websites or other books – they could choose to describe five animals and plants in some detail, looking especially for ways in which those animals and plants are suited to the conditions in that biome. The creatures of the abyssal depths are especially fascinating!

DZone Posters: Students could make Danger Zone posters, based on the Danger Zone photographs in the book, using their own words and pictures.

(Not-So-)Trivia(l) Championship: Students could use the Fact Boxes and Interesting Facts to compile a list of trivia questions and do some research to find out more, then hold a contest for environment trivia champion.

PART III EARTH FUTURE?

Make sure students are really clear about the difference between pages 42-3 and pages 44-5. They also need to understand that greenhouse gases already in the system will keep on causing global warming for decades to come.

page 46 **'**What we can do'.

Class discussion: What can each student see is possible to change within his or her family? What else could they do, as a class? Has anyone been involved in the Greenhomes Project? The class could make some lists or reminder cards to help change habits.

page 47 Is the message of this book a hopeful one? Compare this with the lines of text on page 4. Do these two pages make a good summary of the book?

Board game: Some students might like to devise a board game called Planet Earth (or their own title) based on the book.

ABOUT THE AUTHOR

John Long is Head of Sciences at Museum Victoria, a prolific and highly respected scientist and science communicator. His list of publications includes many books and articles in his special field of paleontology (fossil fish and marsupial lions are among his discoveries) and dinosaurs, including a book about dinosaur smugglers. He has published a number of books for children, both fiction and non-fiction.

John began collecting fossils when he was seven and he found his first dinosaur bones near Inverloch, Victoria, when he was a university student. Since then he has travelled around the world on fossil expeditions. John now lives in Melbourne with his wife Heather, and one of his favourite hobbies is martial arts – he has a black belt in karate!