

THE STORY OF PLANET EARTH

Renu Anand



From the Desk of Dr Ajay Mathur

Earth – our common home – is a small entity in the vast cosmic arena, yet it is truly unique and extremely benign. Henry David Thoreau rightly said, “Heaven is under our feet as well as over our heads.” The atmosphere of Earth is life sustaining; its water bodies are blessed with blue oceans, streams, and rivers. In its bountiful biomes – the coral reefs, polar tundra, tropical rainforests, and temperate grasslands – a wide variety of flora and fauna dwell. A colorful range of landforms – the savannas, mountains, valleys, ice caps, and deserts – support life in all its abundance and diversity.

Today it is difficult to even believe that billions of years ago, the Earth was just a hot mass of rock with no trace of life on it. Scientists say that life emerged in the ocean 3.5 billion years ago, and it began to sprawl across land. Amphibians, reptiles, dinosaurs, mammals, primates, birds, flowering plants, insects, all apes, and our species, homo sapiens evolved on this wonderfully diverse planet. Earth’s continental landmasses, moved, split, and merged to acquire their current positions, while giving birth to the majestic Himalayas, Rockies, Andes, and Alps. The climatic spells of abrupt warming and cooling shaped Earth’s topography and had a great impact on its life forms including on us humans. For timeless eons, the Earth has endured several cycles of evolution and extinction to attain its extant life-sustaining nature.

Quite ironically, humans – the most intelligent species on Earth – are causing irrevocable damage to the planet. High population densities and human avarice have laid undue pressure on Earth and its limited natural resources. Not only this, but humans have created weapons of mass destruction – nuclear, radiological, biological, and chemical – that can end the entire life on Earth in seconds. The US environmentalist Terri Swearingen (1957-) has famously said, “We are living on this planet as if we have another one to go to.”

A future sentence which provides an answer to our ability to mitigate the predicament. Maybe tentatively? Else it seems that humans can only harm the planet and are incapable of saving it.

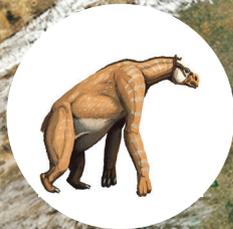
The Story of Planet Earth is a journey into the creation of our Universal Home. I hope this book will inspire young readers to work with a sense of urgency to mitigate the predicaments our sacred planet is facing at present. There is no time for inaction. Responsible and aware deeds – big or small – can contribute to the planet’s well-being. Initiative can be taken at all levels starting from homes, schools, and communities in order to ensure a prosperous and self-sustaining future for Mother Earth.



Ajay Mathur

Director-General, TERI

THE STORY OF PLANET EARTH



The Energy and Resources Institute



An imprint of The Energy and Resources Institute

© The Energy and Resources Institute, 2016

First published in 2016 by
The Energy and Resources Institute
TERI Press

Darbari Seth Block, IHC Complex, Lodhi Road, New Delhi 110 003, India

Tel. 2468 2100/4150 4900, Fax: 2468 2144/2468 2145

India +91 ■ Delhi (0)11

Email: teripress@teri.res.in ■ Website: <http://bookstore.teri.res.in>

ISBN 978-81-7993-535-4

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the publisher.

All export rights for this book vest exclusively with The Energy and Resources Institute (TERI). Unauthorized export is a violation of terms of sale and is subject to legal action.

We would like to thank Richard Bizley for permitting us to use his images.

© Richard Bizley www.bizleyart.com

Author: Renu Anand

Publishing Head: Anupama Jauhry

Editorial and Production Teams: Nandita Bhardwaj, Rupak Ghosh,

Ekta Sharma, Himanshi Sharma; Aman Sachdeva

Design and Illustration Teams: Santosh Gautam, Vijay Nipane

Image Researcher: Shilpa Mohan

Printed and bound in India

This book is printed on recycled paper.

CONTENTS

INTRODUCTION	4
EARTH: A UNIQUE PLANET	6
THE BIRTH OF EARTH	8
FORMATION OF THE CONTINENTS	11
GEOLOGIC TIME RANGE I	14
THE BIRTH OF LIFE	16
CAMBRIAN PERIOD	18
ORDOVICIAN PERIOD	20
SILURIAN PERIOD	22
DEVONIAN PERIOD	24
CARBONIFEROUS PERIOD	26
PERMIAN PERIOD	28
GEOLOGIC TIME RANGE II	31
TRIASSIC PERIOD	32
JURASSIC PERIOD	35
CRETACEOUS PERIOD	38
GEOLOGIC TIME RANGE III	42
PALEOGENE PERIOD	44
PALEOCENE EPOCH	46
EOCENE EPOCH	49
OLIGOCENE EPOCH	52
NEOGENE PERIOD	54
MIOCENE PERIOD	56
PLIOCENE EPOCH	61
QUATERNARY PERIOD	66
PLEISTOCENE EPOCH	78
HOLOCENE EPOCH	86
THE LIVING PLANET	94
SAVING PLANET EARTH	108
GLOSSARY	120

INTRODUCTION

For thousands of years, man has wondered: How was the Earth formed? What is it made of? How old is it? How life began on it? Scientists have undertaken numerous investigations to find the answers. Today, owing to the wonders of modern technology, we know that the Earth is an evolving planet. From core to crust, it is undergoing continuous changes at an amazing pace. At the same time, we also realize how precious and special our planet is – the only known planet with oceans of water and an atmosphere rich in oxygen – as it sustains life. It would be imprudent not to learn from our planet's past, while addressing its dynamic present. But there's still so much more left to know about this blue marvel of the Universe.

Evaluating the Earth's size

The Greek astronomer Eratosthenes of Cyrene (276–194 BCE) conducted the earliest documented experiment to measure the Earth's size. He noted that at noon on the summer solstice, the Sun was directly overhead in the town of Syene (Aswan) in Egypt. He observed a vertical post that didn't cast a shadow. In contrast, a similar vertical post

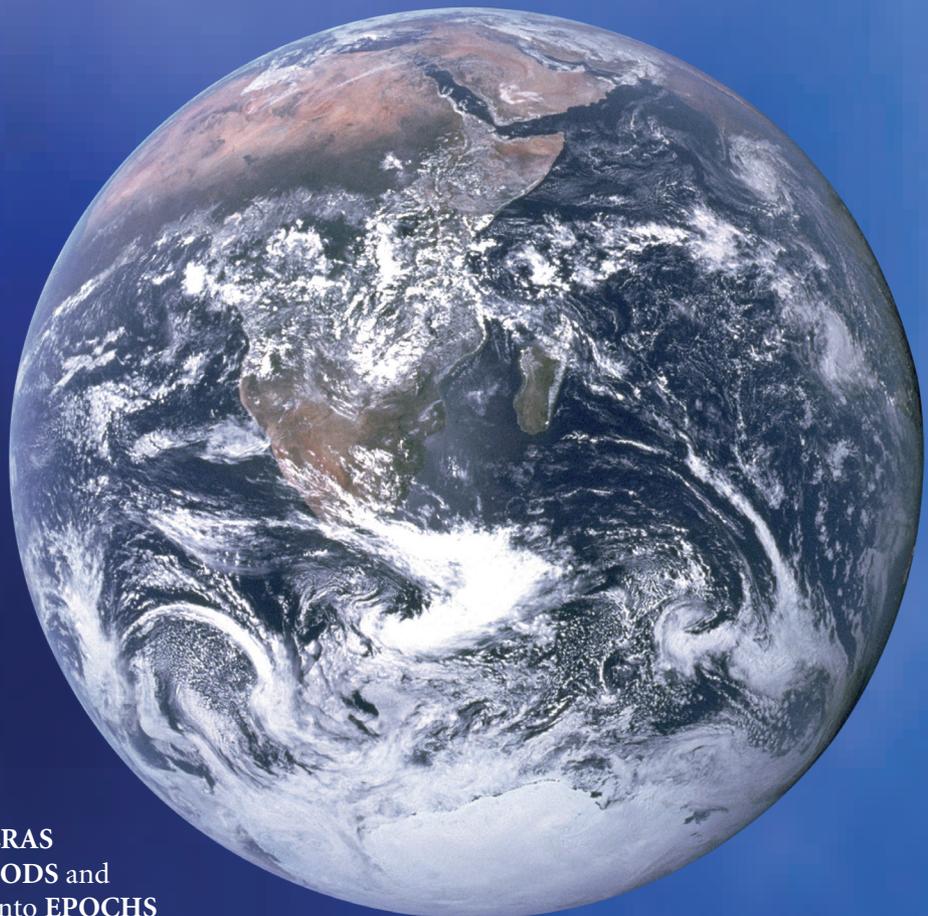
did cast a slight shadow at the same time in the coastal city of Alexandria, located about 800 km to the northwest of Aswan. Correctly assuming that the Sun's rays are almost parallel when they reach the Earth, Eratosthenes calculated the Earth's circumference to be 250,000 stadia. The exact length of a stadia is unknown; however, it is believed that his measurement might have varied a little from the modern established value.

ABBREVIATIONS

BYA – Billion years ago
MYA – Million years ago
KYA – Thousand years ago
YA – Years ago
BCE – Before Common Era
CE – Common Era
c. – Circa

GEOLOGIC TIME

- The largest unit is **EON**
- An **EON** is subdivided into **ERAS**
- An **ERA** is divided into **PERIODS** and
- The more recent **PERIODS** into **EPOCHS**



Legends about Earth's age

Since time immemorial, philosophers and thinkers have been making speculations about the age of Earth.

c.39,575 BCE	Estimated to be the year of creation of Earth by the Egyptian priest Manetho, who lived possibly during 330 BCE
c.39,000 BCE	Believed to be the year of creation of Earth in ancient China
3761 BCE	Believed as the year of the world's creation by the earliest Hebrew thinkers
3114 BCE	The date set by the Mayans
5500 BCE	The date mentioned in the Holy Bible's Old Testament
4000 BCE	The date mentioned in the Holy Bible's New Testament

Scientific theories

Scholars proposed several scientific theories in the 18th and 19th centuries about the creation of Earth.

1

The “salt clock” method was suggested in 1715 by the English astronomer Edmund Halley, but it was flawed. The basic premise of the technique suggested the oceans did not contain any salt when they were formed and that any salt dissolved in the ocean stays there permanently. The first assumption can't be proved and the second one is incorrect, because elements of the ocean continuously leave and return via water cycle.

2

Every year, rivers and wind deposit an estimated 20 billion tonnes of sediment in the oceans. Of this, only one billion tonne of sediment goes away from the seafloor annually, according to Dr D R Humphreys, a physicist. So the current average rate of sediment on the ocean floor (400 m in thickness) would have taken about 12 million years to form. In short, he believes Earth can't be over 12 million years old, but his theory is flawed too. Different sediments with different compositions do not get dissolved in water at the same time, and the seafloor is constantly created and destroyed due to tectonic movements.

3

In 1799, William Smith, an English surveyor of canals, pointed out that the fossils of a particular kind were always found in the same layers (strata) of sedimentary rock. This method too did not help, as it only labelled rock layers as older, or younger, than others.

4

The British geologist Sir Charles Lyell (1797–1875) proposed that the same geological processes occurring today have operated since the beginning of time. While Lyell avoided quantifying the Earth's age, Charles Darwin (1809–82) speculated that 300 million years might be enough time to account for the geologic changes that Lyell had written about.

5

The British physicist Lord Kelvin (1824–1907), however, refuted Darwin's argument. He suggested that the Earth had originated as a hot molten body and that it was 20–400 million years old. Kelvin's estimate was flawed too, as he didn't take into account the heat produced by radioactive elements. Modern scientists opine that the Earth originated as a cloud of cool dusts and gases, warmed up due to the heat released by these radioactive elements.

6

With the help of precise dating techniques and instrument in the 20th century, the American chemist Bertram Boltwood (1870–1927) observed that the ratio between lead and uranium found in local radioactive rocks is usually highly uniform. This led him to conclude that lead is the final decay product of uranium. So he developed the radiometric dating method to estimate the age of rocks.

7

Using the uranium-lead and other, newer methods, geologists have dated a number of ancient rocks from Antarctica, South Africa, Australia, the Soviet Union, and North America. Their findings suggest that the oldest of these rocks were formed about 3.8 BYA. However, no rock has been identified as part of Earth's original crust. And, study of some meteorites or planetoids indicates the age of the Earth as being nearly 4.6 billion years.

EARTH: A UNIQUE PLANET

Earth is the only known planet in our solar system that has large landmasses, meaning continents, and over a million islands. These landforms are surrounded by deep oceans and hundreds of thousands of streams and rivers. These continents, with huge plains, high mountains, deep valleys, ice caps, and deserts are largely covered with green vegetation. However, in the second half of the 20th century, we have caused changes beyond precedent to this precious, unique, and finite planet.

The inhospitable planets

Other planets in our solar system are all very different from the Earth. Scientists studying the Earth and the rest of the cosmos feel that the chances of life occurring anywhere else in the solar system are remote. "So far, we haven't found it (life) anywhere else," says Alex Wolszczan of Pennsylvania State University, who co-discovered the first planets beyond our solar system. Mercury is seared by unbearably hot temperatures, due to its closeness to the Sun. The atmosphere of Venus, the brightest planet, is thick enough to trap the heat of the Sun, which gives it a blazing surface temperature of 471°C. Then comes Earth, beyond which exists Mars. Recent studies show signs that life might have existed on Mars, at least once. However, it is now a cold, waterless planet with a thin, dead atmosphere. Jupiter and Saturn, the gaseous giants of the solar system, are cold, hostile worlds. Some scientists believe that life might dwell beneath the frozen surface and wastelands of Europa, one of Jupiter's moons; however, this is mere speculation as yet. Uranus is so far from the Sun that its temperature remains below -200°C, making it the coldest planet of the solar system. Farthest from the Sun, Neptune is so distant that the Sun's light barely warms the planet. Also, its atmosphere, which includes methane gas, has the highest known wind speeds in the solar system with speeds near 1200 mph, which is faster than the speed of sound here on Earth, tearing at the planet's barren icy surface.



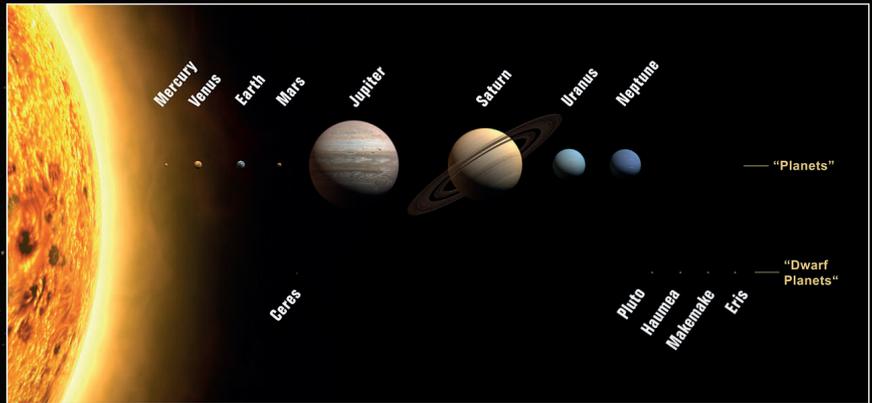
Did You Know

NASA has confirmed the presence of water, although salty, on Mars. John Grunsfeld, astronaut and associate administrator of NASA's Science Mission Directorate in Washington, says, "Our quest on Mars has been to 'follow the water,' in our search for life in the Universe, and now we have convincing science that validates what we've long suspected."



A photograph of Mars

PLANET	TEMPERATURE °C		ATMOSPHERE
	MAX	MIN	
Mercury	430°	-180°	very thin atmosphere of hydrogen, helium, and oxygen
Venus	449°	449°	thick carbon dioxide (CO ₂), some nitrogen
Earth	58°	-88°	nitrogen, oxygen, argon
Mars	20°	-140°	CO ₂ , nitrogen, argon
Jupiter	-145°	-153°	hydrogen, helium
Saturn	-70°	-250°	hydrogen, helium
Uranus		-224°	helium, methane
Neptune	-200°	-210°	hydrogen, helium, methane



Our Solar System

SIZE

Another "just-right" aspect of Earth is its size. If the size of our planet was much smaller, it wouldn't have been able to retain its precious atmosphere, and if it was much larger, it might have become a gas giant too hot for life.

MOON

Scientists believe that we may also owe a debt to our nearest celestial neighbour, the Moon. It regulates our planet's rotation, preventing drastic movements of poles. This might have helped in stabilizing climate, which, in turn, caused life to form or evolve. Then the waxing and waning of Moon also causes tides in the oceans. This, according to scientists, might have made Earth the perfect place for early life to begin, evolve, and survive.

WATER

Earth has water in liquid form on its surface, in an amount conducive to sustain life. The Earth is remarkable for it contains the right amount of water, not too much to cover the mountains, and not so little that it's a dry desert, as are Mars and Venus, our "sister" planets. Earth's water is also special in that it has remained liquid for so long. This is due to Earth's "just-right" location in the solar system. If it were closer, it would receive too much energy from the Sun, if it were farther out, it would have frozen.

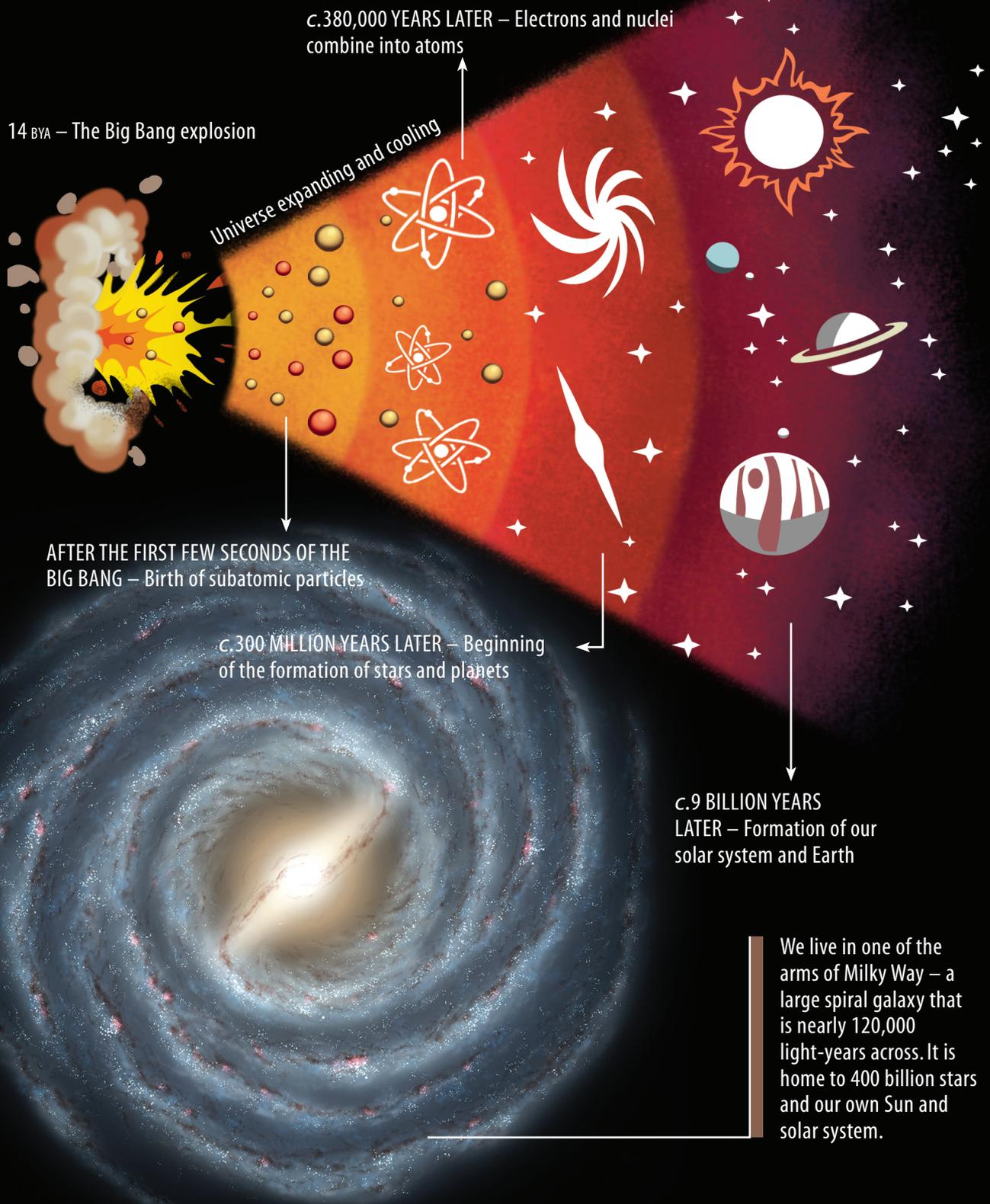
EARTH'S CRUST

Earth's crust is made up of different types of rocks, and it is composed of several rigid segments or tectonic plates that migrate across the surface over a period of millions of years. The slip-sliding movements of these plates have created the towering mountain ranges and deep oceans. Importantly, these tectonic plates allow for the carbon-silicate cycles to operate over geological timescales. This helps regulate temperature and keeps water in liquid state.

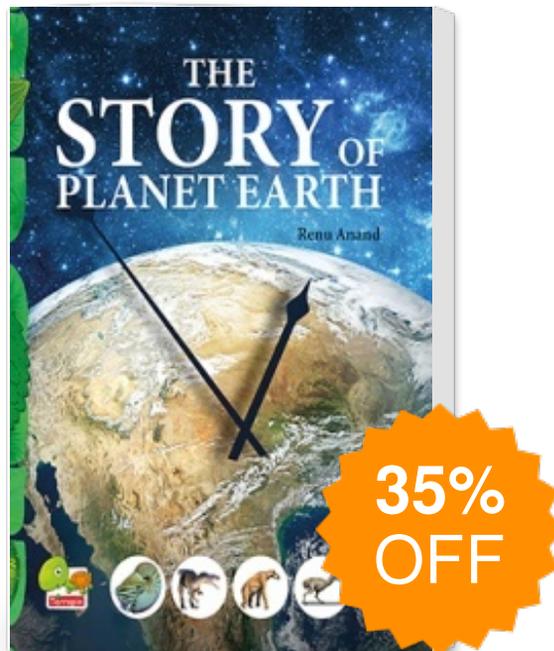
THE BIRTH OF EARTH

In the beginning, there was no Earth and no Sun. Our Solar System, with the Sun in the centre and the planets with their accompanying moons, is a relative newcomer – 4.567 billion years old – in the 14-billion-year-old cosmos.

THE BIG BANG THEORY



The Story of Planet Earth : An attempt to share the history of Planet Earth from stardust to the present



Publisher : **TERI Press**

ISBN : **9788179935354**

Author : **Renu Anand**

Type the URL : <http://www.kopykitab.com/product/8470>



Get this eBook