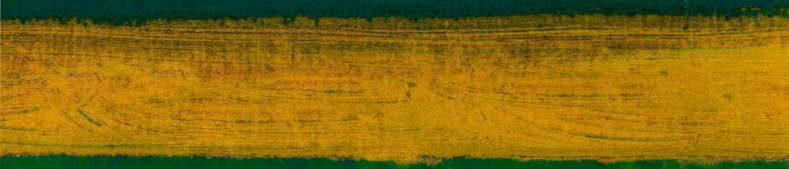
Timothy Clifton

GRAVITY

A Very Short Introduction



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Preface

This is a book about gravity. Gravity is what causes massive objects to fall towards each other. It's gravity that causes apples to fall from trees, and it was gravity that caused the Earth to form. Gravity is the most familiar of all the fundamental forces of nature, yet the true way in which gravity works is far from obvious. In reality, the phenomenon we refer to as 'gravity' is deeply tied up with the nature of space and time. This means that a modern understanding of gravity doesn't just tell us how objects in the Universe move, it also allows us to understand the behaviour of the very space and time that make up the fabric of the Universe itself.

The purpose of this book is to give the reader a very brief introduction to various different aspects of gravity. We start by looking at the way in which the theory of gravity developed historically, before moving on to an outline of how it is understood by scientists today. We will then consider the consequences of gravitational physics on the Earth, in the Solar System, and in the Universe as a whole. The final chapter describes some of the frontiers of current research in theoretical gravitational physics.

By the end, I intend to have conveyed to the reader not only what gravity is, but how the study of gravity has led scientists to reach extraordinary conclusions about the nature of space, time, and the Universe in which we live.

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Chapter 1
From Newton to Einstein

Gravity is by far the weakest of the four fundamental forces that exist in nature—the others being the electromagnetic force, and the strong and weak nuclear forces. Yet over large distances it is gravity that dominates. This is because gravity is only ever attractive and because it can never be screened. So while most large objects are electrically neutral, they can never be gravitationally neutral. The gravitational force between objects with mass always acts to pull those objects together, and always increases as they become more massive.

It is thanks to geniuses like Newton and Einstein that we understand gravity at all, yet it is gravity, more than any other force, that continues to present scientists with the most enigmatic of puzzles. To understand why, let's start at the beginning, and consider the historical development of gravity.

The pre-history of gravity

It seems safe to assume that mankind has always known that when we drop an object it will fall downwards. In this sense, we've always been aware of the existence of gravity. It was the cause of this motion that appears to have been the focus of many early thinkers.

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