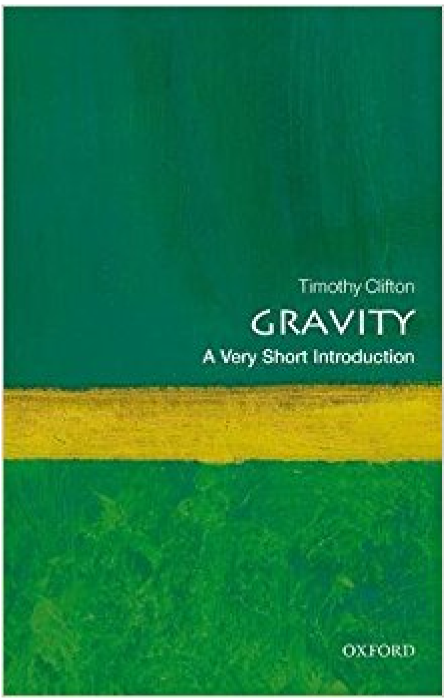
Gravity: A Very Short Introduction (Very Short Introductions)



Synopsis

Gravity is one of the four fundamental interactions that exist in nature. It also has the distinction of being the oldest, weakest, and most difficult force to quantize. Understanding gravity is not only essential for understanding the motion of objects on Earth, but also the motion of all celestial objects, and even the expansion of the Universe itself. It was the study of gravity that led Einstein to his profound realizations about the nature of space and time and all astrophysical bodies within it. In this Very Short Introduction, Timothy Clifton looks at the development of our understanding of gravity since the early observations of Kepler and Newtonian theory. He discusses Einstein's theory of gravity, which now supplants Newton's, and shows how it allows us to understand why the frequency of light changes as it passes through a gravitational field, why GPS satellites need their clocks corrected as they orbit the Earth, and why the orbits of distant neutron stars speed up. Today, almost 100 years after Einstein published his theory of gravity, we have even detected the waves of gravitational radiation that he predicted. Clifton concludes by considering the testing and application of general relativity in astrophysics and cosmology, and looks at dark energy and efforts such as string theory to combine gravity with quantum mechanics.ABOUT THE SERIES: The Very Short Introductions series from Oxford University Press contains hundreds of titles in almost every subject area. These pocket-sized books are the perfect way to get ahead in a new subject quickly. Our expert authors combine facts, analysis, perspective, new ideas, and enthusiasm to make interesting and challenging topics highly readable.

Book Information

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Customer Reviews

Dr Timothy Clifton studied under John Barrow in Cambridge and is now a lecturer at Queen Mary, University of London. He is a specialist in gravitational physics. He has published many research papers on the subject, as well as co-authoring a cover story on gravity in Scientific American.

As is usual for these Oxford short introductions, there is a lot of information in a relatively short book. My first question is what is the audience for the book? I am interested in the physical sciences so someone with that interest should find the book useful. It also seems to me that if you had a high school or college student that had an interest in physics, this would be a helpful introduction. There’s not much math, which can be a deterrent for some, and if the student likes math, then the book still should pique their curiosity.Professor Chilton starts with a light touch on the ancient’s view of gravity, and a light touch is all that’s needed. He then begins a closer examination of gravity as interpreted by Newton first and then Einstein. The theories of these two scientific giants are deemed "classical." I was a little surprised by this characterization of Einstein’s relativity theory, as I’ve thought of it as a progression from a clockwork universe to a statistical understanding of realityThe book looks at the scientific history that led to Einstein’s breakthrough. As above, the professor doesn’t let this become a history lesson. He is more interested in the science, which is good.Einstein’s description of gravity as an aspect of spacetime upended the common belief in absolute space and absolute time. The historical precedent and particularly the Michelson-Morley experiment deeply informed Einstein and his break with deeply and commonly held beliefs. As I considered the audience for this book, it occurred that Einstein’s characterization of "spacetime" rolls easily off my tongue, but if I was required to explain this to an intelligent and curious 12-year old, I’m not sure what I would say. The math supports the concept, but it’s still difficult to describe it.The professor looks at gravity’s effect on bodies in the solar system and outside the solar system. The precession of the orbit of Mercury was predicted by Einstein’s theory, but not Newton’s . The effect was small, but it was the first validation of Einstein’s theory. The extrasolar tests of gravity came from searching for and finding large, dense objects outside the solar system such as pulsars, binary pulsars, white dwarf stars and other objects to look for the effect of gravity on light and electromagnetism.The author describes many experiments from the 16th century to as recently as 2014 to examine their methodologies and findings on the effect of gravity. He also looks at the types of new equipment being constructed at the present time to assist scientists in their ongoing efforts to understand gravity. So, he looks not only at the past, but also at scientific equipment under construction for use in the near future.The most interesting part of the book arises when he looks at the effect of quantum mechanics on cosmology and gravity. Einstein's theory of relativity and quantum mechanics have both been proven experimentally, but the two theories are not consistent. The professor describes efforts to harmonize the two theories. The efforts at harmonization seem strained, but scientists seem to believe that quantum mechanics offers a more complete explanation of physics and relativity, like Newton's laws, offers a more limited explanation.The author does a good job of offering a great deal of information in the short introduction format. The cosmology section is fascinating. If you or someone you know has an interest in physics, I recommend the book highly.

For non-scientists, like myself, gravity is a slightly mysterious activity, when we think of it at all. The book's title says it all: A Very Short Introduction. Timothy Clifton covers the history of gravity science, present theories, and future research focus. Pretty much all non-scientists need to know about the topic. After reading the book, I have a greater understanding of how much we do not know about gravity, and that some of the current terms, such as dark matter or dark energy, might be more like placeholders as we wait for scientists to learn more about this subject.