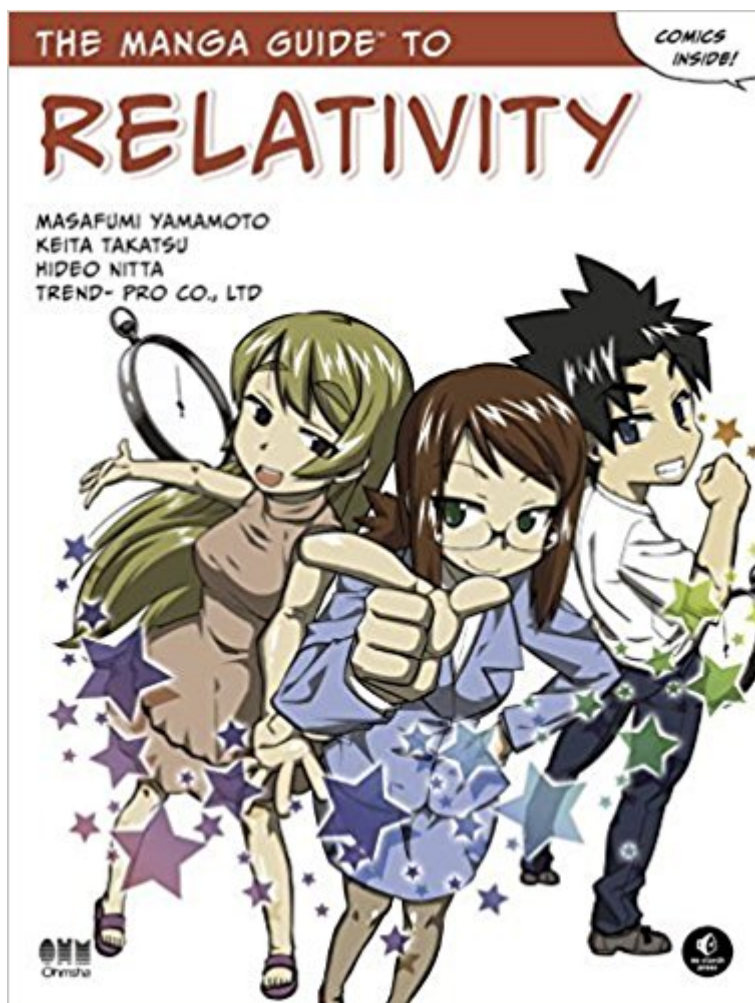


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# The Manga Guide To Relativity



## Synopsis

Everything's gone screwy at Tagai Academy. When the headmaster forces Minagi's entire class to study Einstein's theory of relativity over summer school, Minagi volunteers to go in their place. There's just one problem: He's never even heard of relativity before! Luckily, Minagi has the plucky Miss Uraga to teach him. Follow along with *The Manga Guide to Relativity* as Minagi learns about the non-intuitive laws that shape our universe. Before you know it, you'll master difficult concepts like inertial frames of reference, unified spacetime, and the equivalence principle. You'll see how relativity affects modern astronomy and discover why GPS systems and other everyday technologies depend on Einstein's extraordinary discovery. *The Manga Guide to Relativity* also teaches you how to: "Understand and use  $E = mc^2$ , the world's most famous equation" "Calculate the effects of time dilation using the Pythagorean theorem" "Understand classic thought experiments like the Twin Paradox, and see why length contracts and mass increases at relativistic speeds" "Grasp the underpinnings of Einstein's special and general theories of relativity" If the idea of bending space and time really warps your brain, let *The Manga Guide to Relativity* straighten things out.

## Book Information

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Grade Level: 7 and up

## Customer Reviews

Masafumi Yamamoto earned his PhD in Applied Physics from the Graduate School of Engineering at Hokkaido University. His numerous publications include books on physics, electromagnetism,

and lasers.

I really liked this book. It's an illustrated story about the student body president who volunteers to learn about relativity from the cute physics teacher, in order to save the rest of the class from punishment from the cruel principal. Since I've read this book, I've read a few other books on relativity, and this is by far the best book. I highly recommend it to everyone, since relativity is an ill understood topic that everyone should really know about. I thought the manga format of this story was wonderful, as it quickly takes us into space, and quickly back to Earth. This illustrates some otherwise difficult concepts that are hard to visualize without jumping out into space, and then coming quickly back to Earth to apply them. Even though it's manga, it has a lot of pages of technical details, so this book has some good content, and isn't just a quick read. Pros: +Great artwork +Great story +The best introduction to relativity that there is! Cons: -The technical details in the fine-print pages take a long time to read -Spends almost all of the time on specific relativity, and skims over general relativity

I expected that via the medium of manga, the subject of relativity could be more clearly explained or covered in a different manner from the usual mode of textbooks. However, there were a few blocks of pure text that more or less duplicated the work of textbooks. On the other hand, perhaps I was expecting too much. I wanted to experience an epiphany of understanding but it never really happened for me. This may be due to the fact that relativity was not an entirely new subject to me. For someone new to the subject, it may be an insightful adventure. I am still looking forward to the other books in the series of "The Manga Guide to...".

This is an amazing book. It is interesting and I find myself learning more by following an interesting story than listening to an 800 year old man explain the subject matter while reading from a book. This book was suggested by one of my teachers and I enjoyed it so much that I bought the whole series. I highly recommend this.

These education books are very nice and are easy to relate with the information in these books. These are great.

fun intro for the grandkids.

fun.

Great

First off, let me set the expectation here. I'm a software tester by trade. I'm fan of science (as opposed to being a scientist). I'm also a huge fan of Japanese animation, which is commonly referred to in America as "Anime" in its video format, and "manga" in its illustrated paper format. In short, yes, I'm a grown man who enjoys comic books and I have absolutely no shame in saying that whatsoever ;). Anime and manga is used to reach many audiences in Japan; it's not just geared towards kids. Stories range from the fanciful to the dark and gritty. In between, every conceivable topic and interest is covered and illustrated in a way that grabs attention, entertains, and helps inform the readers on an emotional level. This combination of storytelling, emotion, quirky characters and an illustration style that's both cute and engaging helps lend it to the idea that "hard topics" can be discussed using manga, and that the topic will be much more engaging for the reader. "the Manga Guide to..." series is an example of this, and covers a broad variety of interesting, difficult and sometimes downright geeky topics. In some ways, "The Manga Guide to..." series can be seen as being on par with "Standard Deviants". The most recent title, "The Manga Guide to Relativity" (written by Hideo Nitta, Masafumi Yamamoto and Keita Takatsu) uses the classic story techniques common to most fans of manga; student body president Ruka Minagi takes on a challenge from Rase Iyaga, the sadistic and capricious school headmaster (who also has a penchant towards androgyny, but hey, for anyone with more than a passing familiarity with Manga titles, this is par for the course) to write a report about relativity, thus sparing the rest of the class from having to do it over summer break. If he succeeds, the rest of the class will be spared the assignment. If he fails, he has to agree to be Iyaga's "personal assistant" for the next school year. All is not lost, though, as Physics teacher Alisa Uruga agrees to teach Minagi about relativity so that he can complete the challenge. With that, an adventure begins. During this process, the reader almost forgets that they are actually looking at a topic that is fairly challenging to explain, the theories of Special and General Relativity. Instead the focus is on a fun and engaging story (and not a few quirky characters... did I mention the Vice Headmaster is a dog? OK, I'll mention it). So can a "comic book" really teach us one of the trickier scientific topics? Let's find out... What is Relativity? The first chapter helps us get into the mindset of our protagonist Minagi and his sensei Uruga as they discuss the differences between special and general relativity. The history of relativity from Galileo and Newton on through Einstein and the idea that the speed of light is a constant and the fact that all reality is in

constant motion is explored. The illustrations are both cute and informative, and help fill in the blanks for many of the concepts that might be difficult to visualize any other way. At the end of the chapter a full breakdown of the concepts and some background information is presented again to help drill home the ideas (this also allows those who want to have a nice outline and paragraph explanation of the principles a chance to get that along with Minagi's exploits).

### What Do You Mean Time Slows Down?

A Japanese fable leads off this section, the story of Urashima Taro. the legend tells about a man who rescues a turtle and brings him to the undersea palace of the dragon god. When he returns home back to land, instead of a few days having passed, several hundred years have passed. This idea is called the Urashima Effect in Japan, and is called the Rip Van Winkle effect in western countries. In both cases, the concept covered is Time Dilation. Time dilation is the situation where as an object approaches the speed of light, time slows down for the object. the manga guide uses an imaginary device called a "light clock" to help define how this idea works. this is further emphasized with a visual idea of the Twin Paradox, where a twin goes on a space voyage for a year at light speed and returns to Earth, and sees that their twin has aged by several years in their absence.

### The Faster an Object Moves, the Shorter and Heavier It Becomes?

Wow, Sensei Uraga looks pretty hot in a bikini... have I piqued your attention yet ;)? Hey, it's a manga, what can I tell you? OK, back to the topic... Sensei Uraga continues the discussion with the idea that, when an object gets towards the speed of light, it contracts (and demonstrates in a breakdown the equation necessary to prove this idea, i.e. the Lorentz Contraction). Space and time are said to contract based on this theory of specific relativity (remember, thus far that's what we've been looking at, general relativity comes later) and because of this, we need to look at Space and time as not separate entities, but interlocking entities. additionally, objects get progressively heavier as they approach the speed of light (except for light, which by its very nature is assumed to have a mass of zero for it to work the way it does). Incidentally, this is why it is believed that no object of any measurable mass will ever get to break through the light barrier (science fiction story writers and Start Trek fans notwithstanding. the relationship between mass and energy are also discussed here (the famous  $E = mc^2$  equation and what it really refers to).

### What Is General Relativity?

Special relativity takes the idea that gravity and motion for an object travels in a straight line. General relativity is more mathematically complicated, because the gravity of nearby objects (such as stars) has a direct effect on the object in motion, and that gravity has to be accounted for. In addition, light "bends" as it makes its way around an object with a large gravitational pull. Time also slows down as it passes such a large gravitational pull as well. The idea is called the Equivalence Principal and states that "the inertial force accompanying accelerated motion is indistinguishable from gravity, and

therefore, they are the same." This is compared to the feeling of pressure you feel in an accelerating and decelerating train, or in an elevator as it goes up and down, or on an amusement park ride like the spinning swings. A demonstration is shown where a bowling ball is placed on a tightly pulled rubber sheet. When the bowling ball is placed on the sheet, the sheet indents to make room for the ball. Put another one on the same sheet at the opposite end of the sheet, and it will make its own indentation. Give enough time, and the balls will slowly move towards each other. This shows that gravity is really the bending and warping of space (yeah, I had to read that one a few times :)).

General relativity also takes into account that matter, space and time all have interactive relationships, and while it's a "theory" there are devices we use everyday that depend on this theory and in its actions prove it works (GPS, anyone :)?). We can really take this to the mind bending level of looking at the universe (by the theory of General Relativity, observations indicate our universe is expanding). Bottom Line: That's a lot of detail packed into a manga. The cool thing is that it's entertaining, fun to read, and in many ways, the ideas and theories come naturally, and it's only when you put down the book and realize "wait a minute... did we just cover what I think we covered?!" That's the great success of this book, in that you learn new ideas and concepts without really having to think about it too much. You're having too much fun to realize how much you are learning. On that level, The Manga Guide to Relativity succeeds very well. So how does Minagi do on his report? Can sensei Uruga deliver the goods? And what is it about that dog, anyway?! For answers to those riddles (and many others within the Relativity metaverse), you'll just have to pick up a copy of The Manga Guide to Relativity and find out for yourself.

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