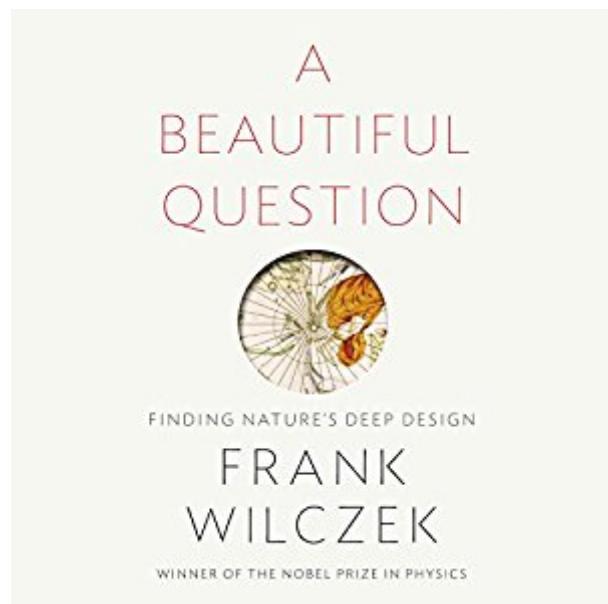


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# A Beautiful Question: Finding Nature's Deep Design



## Synopsis

Does the universe embody beautiful ideas? Artists as well as scientists throughout human history have pondered this "beautiful question". With Nobel laureate Frank Wilczek as your guide, embark on a voyage of related discoveries, from Plato and Pythagoras up to the present. Wilczek's groundbreaking work in quantum physics was inspired by his intuition to look for a deeper order of beauty in nature. In fact, every major advance in his career came from this intuition: to assume that the universe embodies beautiful forms, forms whose hallmarks are symmetry - harmony, balance, proportion - and economy. There are other meanings of "beauty", but this is the deep logic of the universe - and it is no accident that it is also at the heart of what we find aesthetically pleasing and inspiring. Wilczek is hardly alone among great scientists in charting his course using beauty as his compass. As he reveals in *A Beautiful Question*, this has been the heart of scientific pursuit from Pythagoras, the ancient Greek who was the first to argue that "all things are number", to Galileo, Newton, Maxwell, Einstein, and into the deep waters of 20th century physics. Though the ancients weren't right about everything, their ardent belief in the music of the spheres has proved true down to the quantum level. Indeed, Wilczek explores just how intertwined our ideas about beauty and art are with our scientific understanding of the cosmos. Wilczek brings us right to the edge of knowledge today, where the core insights of even the craziest quantum ideas apply principles we all understand. The equations for atoms and light are almost literally the same equations that govern musical instruments and sound; the subatomic particles that are responsible for most of our mass are determined by simple geometric symmetries. The universe itself, suggests Wilczek, seems to want to embody beautiful and elegant forms.

## Book Information

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## Customer Reviews

This is a rumination on beauty in the world. Nobel Laureate Frank Wilczek who is one of the most acclaimed theoretical physicists of his times brings us a chronicle of what beauty in science means. He focuses mainly on physics but does not neglect other sciences. The book is thoughtfully written and is beautifully illustrated with images from art, science and history. It reveals a mind that is as comfortable probing the deep mysteries of the cosmos as it is pondering the everyday objects of our world. Wilczek's approach is roughly chronological and one of his goals is to reveal the seamless unification of beauty in many different contexts. For instance he starts with an account of Pythagoras's theorem which pointed to a crucial connection between numbers and geometric figures. But Pythagoras also discovered simple and pleasing relationships between musical frequencies and the length of various string instruments. Remarkably, these relationships also mirror some of the relationships found in the wavelike nature of subatomic particles. Thus beauty in sound is connected to beauty at the microscopic level. Similarly Wilczek dwells on Goethe's intriguing ruminations on color. While some of these ruminations were scientifically flawed, Wilczek explores how they connect to our modern understanding of color based on the physics and biology of vision. It is when Wilczek starts talking about beauty in physics that he is really in his element. How does one define beauty in science in general and physics in particular? As we all know, beauty is in the eye of the beholder, but Wilczek convincingly provides some criteria that have guided physicists' search for this elusive but still familiar concept through the ages.

This is a broad, deep and mind-expanding book by a Nobel prize winning physicist covering many topics: "the philosophy of Plato of the link between the nature of reality and the beauty of form, the functioning and limitations of the human sensory perception of electromagnetic waves (light) and of hydrodynamic waves (sound) relative to what is actually out there to be seen; and the history of science from the Greeks to the Standard Model (or Core Theory as preferred by Wilczek), the extraordinary relation between physical reality and mathematics (numbers, geometry, symmetry), the relation of beauty in the form of symmetry to physical reality, the ongoing extensions of the Core Theory using Supersymmetry. Supersymmetry (SUSY for the cogniscenti) is a form of mathematical magic that has particles being changed from one thing in one property space to another in another property space and with transformations that change quantum dimensions into ordinary dimensions without changing the laws of physics. The

fallback position when things don't agree with observation is to postulate that the equations have many solutions and the solutions that have the sought-after symmetry are unstable. Wilczek's description of his and others' efforts to extend The Standard Model, or as he prefers it The Core Theory, particularly around page 300, strongly calls to mind "The Glass Bead Game" (German: *Das Glasperlenspiel*) is the last full-length novel of the German author Hermann Hesse. It was begun in 1931 and published in Switzerland in 1943 after being rejected for publication in Germany due to Hesse's anti-Fascist views.<sup>[1]</sup> The Glass Bead Game takes place at an unspecified date centuries into the future.

A beautiful question begins naturally by posing a question to the reader - Does the world embody beautiful ideas? With this question in mind nobel laureate Frank Wilczek goes on to discuss beauty in nature and the intellectual history of physics. I found aspects of the book enjoyable and illuminating and there is much that a wide range of readers can learn. That being said the book isn't that original in concept and seems to have some overlap with "Fearful Symmetry" by Zee. In particular the associating of symmetry and beauty and how nature is defined by symmetries and therefore one should see nature as beautiful is a much discussed idea by admirers of science. The book is primarily split into topics chronologically. The author starts with Pythagoras and gives an extremely elegant proof of the theorem. The author discusses the history of Pythagoras and the myths surrounding the man. He also goes into some music theory and discusses how pleasant sounds are heard when notes whose frequencies are in simple integer ratios are played. The author throughout provides interesting anecdotes about the subject matter being discussed providing the reader with an appreciation of how nature can be beautiful. The author then goes into Plato and aspects of his teachings put beautiful ideas on a pedestal. Properties of platonic solids are discussed as well as Euclid and how the elements was a book structured methodically to reach a final result about the shape and number of platonic solids. The author discusses how ideas about how nature embodies beautiful ideas can often be far off the mark and uses Kepler's early planetary model to illustrate.

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