“Around 700 BC, a prince named Midas inherited the kingdom of Phrygia... Jealous Apollo...turned Midas's ears into donkey ears when Midas favored someone else over Apollo.” When describing this fantastic tale about the origin of alchemy, Sam Kean retains his logical yet inviting manner as he talks about his chemical elements. His new book, *The Disappearing Spoon*, includes tons of engaging stories about elements as well as mankind. Connecting the chronologies of elements together, Kean creates his own comprehensive encyclopedia about the history and development of the periodic table.

The book does not give each individual element its own chapter but instead organizes the elements into groups, as what happens in a periodic table. However, the grouping is a little different: in a periodic table, each group represents similarities in chemical properties, whereas in the book the elements are arranged according to similarities in their adventures of discovery, applications or special properties. The title of the book “The Disappearing Spoon” comes from a special element gallium. Gallium, silvery and shiny, is a metal that looks no different from other metals. However, if one puts a spoon made by gallium instead of silver or stainless steel into a cup of hot tea, the spoon will soon disappear! Gallium has such an exceptionally low melting point that it melts even below the boiling point of water. The book is built upon extraordinary stories about chemical elements. Other books on the same topic usually explore deeply in one or several issues. Although they allow the audience to focus on the issues, they somehow limit the audience from making generalizations. Kean writes about every element and allows the audience to gain different perspectives from the various stories about chemical
elements and have a broader view on science.

The book has a chronological structure, starting from the most fundamental elements such as carbon and ending with fancy radioactive elements. This structure also helps Kean achieve his goal to write the whole “history of the world from the periodic table of the elements” by depicting the development of modern science. He covers a broad range of the progress in science, from the early attempt of alchemists to bubble chambers, detectors of highly energetic particles used in modern physics labs. However, a reader who possesses some background in modern physics might find a mistake in the book where Kean is reluctant to give up Bohr's model of atoms in which electrons take fixed orbits around the nucleus in an atom. Kean has also mentioned the concept of uncertainty principle in the book as well, which proved Bohr's model wrong. Despite this deficiency, the book provides a satisfactory overview of the progress of chemical science.

This book stands out from other books about the history of science because it is not only about the plain fact of making discoveries but also the special, emotional moments in scientific discoveries. Human behaviors can influence the progress of scientific findings both positively and negatively. Kean has illustrated this point through the competition between a Russian lab and an American lab in the 20th century striving for finding new elements. In the beginning, the competition boosted their productivity and brought them new methods. Interaction between scientists resulted in the collision of different ideas that created something new. However, as the competition worsened, one lab reported a new element without meticulous verification while the other announced a discovery by faking experimental data. By telling these stories, Kean shows how humanity can act as both stimulations and destroyers in the realm of science.
Scientists also become emotional when they make funny mistakes. Element forty-three has been discovered for the “first time” many times, as Kean writes “A German chemist announced the discovery of...element forty-three...[which] turned out to be impure iridium [element 77]... Another German discovered “ilmenium,” which was actually niobium [element 41]. The next year someone else discovered “pelopium,” which was niobium, too.” Poor chemists! But Kean does not just make fun of them; he also mentions the unimaginable persistence and diligence of scientists who repeated their experiments for thousands of times in one or two decades just to produce a compound enough for further experimentation. *The Disappearing Spoon* leads the readers to a deeper understanding of the process of scientific research.

However, Kean does not want to create stereotypes of hardworking mad scientists. Instead, he creates personal profiles for scientists. He does offer descriptions to the scientists’ appearances like other books would do, which is not very effective since scientists all look the same, at least when they are in their lab coats. However, Kean's specialty is to condense the whole figure of a person into a few representative actions, usually one or two sentences that stick in the audience’s mind. For example, Kean describes Robert Boyle as a man “who experimented on and even liked to taste the fresh, frothy urine in his chamber pot”, creating a gross but vivid figure.

Kean knows well not only about the scientists but also the science. He has a deep understanding of his materials and thus can make logical connections between seemingly unrelated things in a surprising way. In one chapter of the book “Elements as Money”, he first mentions the effort that different governments made to prevent counterfeit money. Then he jumps to the energy levels in an atom, explaining how electrons can go to
different levels by emitting or absorbing light. In this setting, light acts as “an international currency, redeemable in many forms in the atomic world.” Finally, he tells the readers how the European Union makes real paper currency difficult to forge by adding a layer of europium. Europium emits light according to the principle he has just explained. Therefore, when real paper currency is examined by machine, the emission of a certain color of light will be detected. The lack of this color of light indicates a counterfeit.

Kean's familiarity with chemistry also enables him to create metaphors and analogies in order to make highly abstract science fathomable for common readers. He is like a patient high school teacher who keeps explaining until everything makes sense to his students. For example, he demonstrates Heisenberg's uncertainty principle, which states that accurate measurements regarding both the motion and the position of an object cannot be made at the same time, in terms of a rock thrown into a resting pond. Measuring is to probe the object with a small disturbance and watch the reaction, just like a kid throwing a rock to the resting pond causing wave patterns. However, the object being measured is altered by this small disturbance, as the resting pond is agitated and starts to have water waves, which it does not have in the beginning. By using the analogy of a disturbed pond, Kean explains the intrinsic uncertain nature of measurement. However, analogies no longer make sense if they are exaggerated too much. Kean has made another mistake when he tries to show how astounding superconductors are. His analogy, unfortunately incorrect, says “this would be sort of like cooling an iPod down to hundreds of degrees below zero and finding that the battery remained fully charged no matter how long or loud you played music, until infinity.” Playing music until infinity
requires an infinitely huge source of energy, but superconductors do not have this property.

Kean's book seems a little untimely. New scientific discoveries are updated every month through journals, every moment through electronic sources. Every discovery is so inspiring that people pleasantly forget what they have learned in high school. In comparison, Kean's book is not that inspiring in trying to challenge people’s minds. But Kean is smart enough to pick appropriate substances so that the book covers the significant historical moments and does not have to compete with exponentially growing new information. In this sense, the book is a real encyclopedia as it does not relentlessly try to catch up with the new world but rather waits for history lovers to read.