The Periodic Table of the Elements

The periodic table, that faded chart on the walls of countless science labs, is a remarkable document for many reasons. At first glance, it may appear to be a jumble of unrelated chemical information. However, a closer look reveals the periodic table's highly systematic structure, and the origin of its name. Imagine that the elements were arranged in a line of increasing atomic number. Now imagine that you choose an element within the first 10 or so. At some distance farther down the line, the characteristics of your chosen element will be repeated in another element and repeated again in a third element farther down the line. This repetition of characteristics is the periodic nature of elements. The number of elements between repeating characteristics is called the period.

How this table came to be organized is a classic story in scientific discovery. In the mid-1800s, several chemists recognized regularities in the properties of elements — their densities, melting points, how they react with hydrogen and oxygen, and so on. The group of known elements was beginning to show a pattern, but, to these early chemists, it wasn't clear what that pattern was, because so many elements remained undiscovered. Thus, they searched for patterns using short periods — something akin to identifying the value of every card in a deck of playing cards with only half of the cards to work with. In contrast, Russian chemist Dmitri Mendeleyev created a periodic table with a longer period that included holes to represent what he assumed were missing elements.

Many of Mendeleyev's contemporaries scoffed at his table because it was not nearly as tidy as other periodic tables of the time. However, the Russian was confident in his work, saying that the holes simply represented elements that had not yet been discovered. Mendeleyev's conviction was soon rewarded. Shortly after, several of the predicted elements — gallium, scandium, and germanium — were discovered. These elements closely matched their predicted characteristics and fit neatly into the holes in Mendeleyev's table. Here then was a tool that not only organized the known elements, it also allowed researchers to predict the properties of undiscovered elements, making the search for them much easier. Mendeleyev quickly became the most famous chemist of his day and is credited as the father of the modern periodic table. Element number 101, mendelevium, is named in his honor.

This story is an example of successful research based on observed characteristics. Mendeleyev knew what the periodic table should look like, but he didn't know why. It would take a new century and the work of another group of physicists to reveal the quantum mechanical atom and the source of atomic periodicity.