

Biography: Antoine Laurent de Lavoisier

Antoine Laurent de Lavoisier (1743 – 1794) was a French scientist considered by many to be the father of modern chemistry. His most important experiments investigated the nature of ignition and combustion. While not having discovered any new substances in his lifetime, he improved laboratory methods and devised the system of chemical terminology which is, to a great extent, still used today. He was instrumental in the overthrow of phlogiston theory. Moreover, he proved the law of conservation of mass and discovered that hydrogen, in combination with oxygen, produces water. His work was characterized by organizational skills, abundance of good ideas, universality, and modernism. As a result of his accomplishments, his name appears among the 72 names at the Eiffel Tower.



Lavoisier was born in Paris on August 26, 1743. He was born to an affluent bank-clerk family. At the age of five, he inherited possessions left to him after his mother's death. From a young age, he was interested in nature and he often carried out barometrical and meteorological observations.

In 1754, Antoine started attending Collège des Quatre Nations (Collège Mazarin), which was known for its advanced teaching and focus on Exact and Natural Sciences. Here, he studied mathematics and astronomy. Young Lavoisier was also interested in botany, geology, and mineralogy, and attended some chemistry courses. He left Collège Mazarin in 1761. In the same year, persuaded by his father, he took up Law studies at the University of Paris and obtained his Bachelor's degree on September 6, 1763. One year later on July 26, 1764, he acquired a license to run a solicitor practice.

It was likely due to his studies in Law that his works were so well written, with their meanings always easily comprehensible, clear, well-defined, and fully logical. Antoine always cared about his intellectual property, and therefore he rewrote his works several times, always thoroughly presenting the outcomes of his research. He presented the detailed reports of his observations and conclusions to the Secretary of the Academy of Science, who kept them in sealed envelopes to avoid a dispute over precedence. Probably due to his legal training his core values included sincerity and respect for the law.

During his law studies, young Lavoisier was able to attend lectures on the Natural Sciences. In particular, he was enthusiastic about geology and

mineralogy. It was shortly after his graduation, on August 11, 1764, that he began his apprenticeship in the Parisian Parliament (Parlement de Paris). He was open-minded and curious about everything that surrounded him. Not giving up on his interests, he devoted himself to geology, physics, and chemistry, which resulted in his first published book in chemistry in 1764.

In 1767, he obtained a job working as a geologist in the Alsace-Lorraine. On May 18, 1768, at the age of twenty-four, he was chosen to become a member of French Academy of Science. In the following year, he worked on the first geological map of France, while still carrying out numerous chemistry experiments. He wrote on the origin of chemical elements and combustion. He also experimented with electrical discharges, and compared various barometers.

The daily life of Lavoisier was focused entirely on science. In 1771, he married a 13-year-old young lady named Marie-Anne Pierrette Paulze, who, in time, became an excellent scientific worker. She translated books into English for him (eg., *Essay on Phlogiston*, by Richard Kirwan), as well as Joseph Priestley's research on the nature of heat in chemical reactions and his correspondence with English chemists. She also made drafts of manuscripts and figures of the laboratory instruments used by Lavoisier and his friends. Mrs. Lavoisier managed a small, but lively, science salon where scientists could go to perform their experiments and discuss their ideas. She also corresponded with many French scientists and naturalists who were impressed with her intelligence. To Lavoisier,

she proved to be an outstanding assistant, friend, and partner in his scientific research.

From 1775 onwards, Lavoisier served in the Administration Royale Des Poudres, where his research led to improving gunpowder and inventing a new method of saltpeter production.

Lavoisier's versatility and his legal studies led him to take an interest in politics. At the age of 26, he became a tax collector employed by a private company. While working for the government, he developed a new system of measures which were aimed at the standardization of scales for all of France. However, it was not politics, but chemistry which brought him significant fame.

As mentioned before, Lavoisier is considered by many to be the father of modern chemistry. His most important experiments concerned the nature of ignition and combustion. These experiments showed that oxygen played a central role in both of these processes. Antoine also showed that oxygen plays a key role in respiration for animals and plants, as well as in the process of metal rusting.

He also discovered that hydrogen, in combination with oxygen, produces water, thus contradicting the ancient theory of four elements (water, air, fire, earth).

In *Sur la combustion en general* (About ignition, 1777) and *Considérations Générales sur la Nature des Acides* (Considerations about the nature of acids, 1778), he showed that "air" being an ingredient of the combustion process is also the source of acidity. In 1779, he first used the term "oxygen" for the part of "air" that was responsible for burning, and the term "nitrogen" for the other part of "air."

Lavoisier's experiments were some of the first that could be characterized as quantitative research. He demonstrated that even though matter changed its state in chemical reactions, the overall mass of reactants and products remained equal from the beginning of the reaction to its end. While burning phosphorous and sulfur, he noticed that the product of the reaction weighed more than its reactants. He showed that the surplus weight is compensated for by the loss of the mass of air. These experiments provided the basis for formulating the law of conservation of mass. Lavoisier's explanations led to the overthrow of

the phlogiston theory, which maintained that materials gave off a substance called phlogiston during combustion (*Reflexions sur le Phlogistique*, 1783).

In co-operation with the French scientist Claude-Louis Berthollet, Lavoisier created the chemical nomenclature (*Méthode de nomenclature chimique*, 1787). Its terminology is, for the most part, still in use today, with words like sulfuric acid or sulfates.

In 1786, Lavoisier advocated that the "caloric" theory replace the phlogiston theory. The caloric theory held two basic ideas: first, that the total heat of the universe is constant, and second, that the heat present in matter is a function of the matter and its state. He also assumed that caloric fluid was a substance and in order to measure it, together with Pierre Laplace, created the first water-ice calorimeter.

Lavoisier took advantage of the new calorimeter to determine the quantity of heat produced by guinea pigs and the amount of heat per unit of carbon dioxide produced, and found that the rate of combustion is greater during movement than during rest.

Due to Lavoisier's research, it was possible to establish that food was oxidized after being eaten. As a result of that process, heat was produced simultaneously, which Lavoisier and Laplace measured using the calorimeter. Their research on calorimetry is, to this day, one of the essential elements of teaching about nutrition. Its importance is supported by the fact, that until the early 20th century, caloric value was the sole indicator of the nutrient value of food. Calories were also used to determine how much food a human needed.

Lavoisier was an activist, and was deeply convinced of the need for social reform in France. He was a member of the community in favor of tax reforms and new economic strategies. During the French revolution, he published a report on the financial situation of France. It was shortly afterwards that he was called a traitor by the revolutionists for being a tax collector. For his political and economic views he was sentenced to death. Prior to being executed, he asked the judge for permission to complete his scientific research, first. However, the judge's reply was: "La Ré-

publique n'a pas besoin de savants ni de chimistes; le cours de la justice ne peut être suspendu” (“The Republic needs neither scientists nor chemists; the course of justice cannot be delayed”). He was guillotined in Paris on May 8, 1794, and later buried in the cemetery in Errancis.

References

cti.itc.virginia.edu
historyofscience.free.fr/Comite-Lavoisier/
http://moro.imss.fi.it/lavoisier/en.wikipedia.org/wiki/Antoine_Lavoisier
www.chemheritage.org
www.antoine-lavoisier.com/
www.newadvent.org/cathen/09052a.htm
www.historylearningsite.co.uk/antoine_lavoisier.htm
www.odzywianie.info.pl/Historia-nauki-o-zywieniu.html
scienceworld.wolfram.com/biography/Lavoisier.html

Biography: Antoine Laurent de Lavoisier was edited by Stephen Klassen and Cathrine Froese Klassen and is based, in part on **Historical Background: Food, energy and work – developing a science of nutrition** written by Andreas Junk.

Biography: Antoine Laurent de Lavoisier was written by Grażyna Drażkowska with the support of the European Commission (project 518094-LLP-1-2011-1-GR-COMENIUS-CMP) and Polish Association of Science Teachers, Poland. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.