

Amedeo Avogadro

Born: August 9, 1776, Turin, Italy

Died: July 9, 1856, Turin, Italy



Who is Amedeo Avogadro?

Count Lorenzo Romano Amedeo Carlo Avogadro of Quaregna and Cerreto was a nobleman, a lawyer, and a scientist born on August 9, 1776, in the city of Turin, Italy. He developed a hypothesis in 1811 that gained recognition after his death and became known as Avogadro's Law. Its development led eventually to the designation of a mathematical constant in chemistry called Avogadro's Number. This constant is fundamental in the study of chemistry to this day.



Amedeo Avogadro was born in Turin, Italy.

Avogadro's Life

Avogadro began his career as an ecclesiastical (church) lawyer, having obtained a doctorate in canon law in 1796. During his time as a lawyer, however, he developed a keen interest in science, specifically math and physics. In 1800, he began taking private lessons in math, physics, and chemistry under the tutelage of a mathematical physicist named

Vassali Eandi. Avogadro's first scientific paper, published in 1803 with his brother Felice, was on the electrical behavior of salt solutions and came only three years after Alessandro Volta first demonstrated the electric battery. In 1804, he became a member of Turin's Academy of Sciences.

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In 1811, working off the discoveries of Dalton and Gay-Lussac, Avogadro published a paper in the French *Journal de Physique*, alleging that equal volumes of all gases at constant



Avogadro returned to Turin as a professor of mathematical physics.

temperature and pressure contain the same number of molecules. He realized, for the first time, that elements could exist as multi-atom molecules rather than individual atoms and that oxygen was one of those elements, existing naturally as a 2-atom (diatomic) molecule. In this 1811 paper, he correctly presented formulas for water, nitric and nitrous oxides, ammonia, carbon monoxide, and hydrogen

chloride. He followed this up in 1814 with the formulas for carbon dioxide, carbon disulfide, sulfur dioxide, and hydrogen sulfide.

Unfortunately for Avogadro, his contemporaries strongly disagreed with his hypothesis, when they acknowledged it at all. This was likely due to several factors, including that the distinction between atoms and molecules wasn't well understood, similar atoms were actually thought to repel one another at the time, he represented his findings in a way more easily understood by physicists than chemists, the *Journal de Physique* wasn't widely read, and Avogadro was a homebody, rarely leaving Turin and making no real effort to join the scientific communities centered in France, Germany, England, and Sweden.

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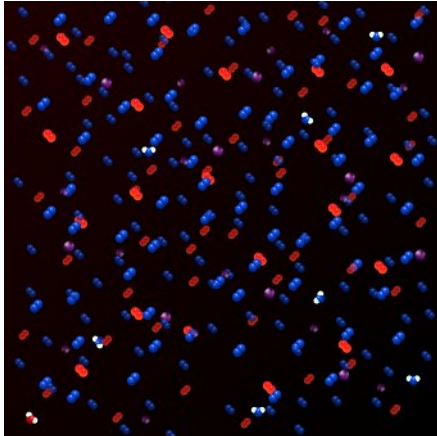
Avogadro Vindicated

In 1860, fellow Italian Stanislao Connizzarro presented Avogadro's hypothesis at the Karlsruhe Conference, which had been called to alleviate scientific confusion concerning atoms, molecules, and their masses. Once again, however, his work was largely unaccepted. It would be another ten years, with Connizzarro remaining a strong advocate, before Avogadro was taken seriously. Today, this hypothesis, that equal volumes of different gasses at equal temperature and pressure have an equal number of molecules, is known as Avogadro's Law.



Avogadro's hypothesis was accepted as a scientific law after his death.

Avogadro's Number



Using Brownian motion, Jean Baptiste Perrin proved the existence of molecules and determined how many atoms are in one mole of a substance.

Jean Baptiste Perrin was born in Lille, France, on September 30, 1870, nearly 60 years after Avogadro first published his hypothesis. As a molecular physicist, Perrin studied Avogadro's work and Einstein's theory of Brownian motion, the random movement of tiny particles in a liquid or gas. He was able to determine the number of units (electrons, atoms, ions, or molecules) in one mole of a substance. A mole, called a "gram molecule" by Perrin, is the standard unit of an element. Each standard unit has an atomic mass. The number Perrin calculated was

$6.02214179 \times 10^{23}$. A mole of carbon, for example, has an atomic mass of 12 grams. Within

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If you spent one billion dollars per second, it would take more than 19 million years to spend it all.

- If you created one million equal piles of paper, all stacked on top of each other, each pile would reach past the Sun.
- If you wanted to collect Avogadro's number of sand grains, you would need to dig the surface of the Sahara desert (area = 8×10^6 km²), approximately two meter down.

Reading Comprehension Questions:

1. When
2. What was Avogadro's first job in the field of science?
3. What
4. Give three potential reasons why Avogadro's hypothesis was not accepted during his lifetime?
5. Who
6. Who
7. What is Avogadro's Number? Give a definition and the number itself.

Extension Questions:

8. What do you think Avogadro himself could have done to improve his standing in the scientific community?
9. How
10. If you could

Reading Comprehension Questions:

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