



15.2 Svante Arrhenius

Svante Arrhenius was a Swedish Chemist who won the Nobel Prize in 1903 for his work on acid and base chemistry. He is also known for recognizing that carbon dioxide (CO₂) is added to the atmosphere when fossil fuels are burned, and that it is a greenhouse gas. Arrhenius calculated that doubling the CO₂ in the atmosphere would increase Earth's temperature by 4-5°C. His prediction, made without computers or modern scientific equipment, is close to current estimates!

Young scholar



Svante Arrhenius was born in 1859 in Wijk, Sweden. His father was a land surveyor. Svante taught himself to read at the age of three. He was a strong student and especially enjoyed math and physics. He graduated at the top of his high school class, although he was the youngest student.

Arrhenius went on to study mathematics, chemistry, and physics at the University of Uppsala in Sweden. In 1881 he moved to Stockholm to study with Professor E. Edlund at the Academy of Sciences. Arrhenius was especially interested in what happens when electricity is passed through solutions. For his doctoral thesis, he proposed that molecules in solutions could break up into electrically charged fragments called ions.

Setback, perseverance, and recognition

Unfortunately, the value of Arrhenius's work was not recognized by the faculty at the University of Uppsala, where he defended his dissertation. The idea that a molecule could break up in water was difficult to accept. Finally, Arrhenius was given a "fourth rank" degree--which meant that he barely passed. Arrhenius could not hope to obtain a university professorship with that degree!

Arrhenius's mentor, Professor Edlund, helped him obtain a travel grant to meet and work with leading scientists in the field of physical chemistry. They helped Arrhenius clarify his ionic theory. In the late 1890's, when electrically charged subatomic particles were discovered, the importance of Arrhenius's work was finally recognized. Arrhenius was awarded the Nobel Prize for Chemistry in 1903.

A man of many interests

Arrhenius was fascinated by many branches of science. He studied electrolytes in the human body, publishing papers about their role in digestion and absorption, and about their function as antitoxins.

Along with his scientific publications, Arrhenius wrote books intended to introduce the general public to advances in various scientific fields. These included *Smallpox and its Combating* (1913) and *Chemistry and Modern Life* (1919).

Arrhenius was also interested in Astronomy. In 1908 he put forth the theory of *panspermy*--which suggested that life may spread through the universe when spores from a life-bearing planet escape their atmosphere and are then driven by radiation pressure across long expanses of space, until they come to rest on another planet where hospitable conditions allow them to flourish. While this theory hasn't withstood the test of time, Arrhenius did contribute to our understanding of the phenomenon known as Aurora Borealis, or northern lights.

Pioneering climate research

Arrhenius was curious about what caused the beginning and end of Earth's ice ages. In 1895, he presented a paper to the Stockholm Physical Society called "On the Influence of Carbonic Acid (CO₂) in the Air upon the Temperature of the Ground." He proposed that variations in the amount of CO₂ in the atmosphere could influence climate.

In 1903, he wrote a book called *Worlds in the Making* in which he explained that atmospheric gases like carbon dioxide trap heat near Earth's surface, increasing its average temperature. In 1904, he suggested that human activity could affect Earth's climate, if industrial emissions increased the amount of CO₂ in the atmosphere. He was not concerned about this increase; in fact he thought that it might be beneficial for growing crops to feed a larger human population.

Arrhenius died in Stockholm in 1927.



Reading reflection

1. Describe Arrhenius's doctoral thesis.
2. What was the setback that Arrhenius had to overcome early in his career?
3. Name three fields of science that interested Arrhenius.
4. Describe a scientific theory proposed by Arrhenius that has never received widespread acceptance.
5. Why is Arrhenius considered a pioneer in the field of climate change study?