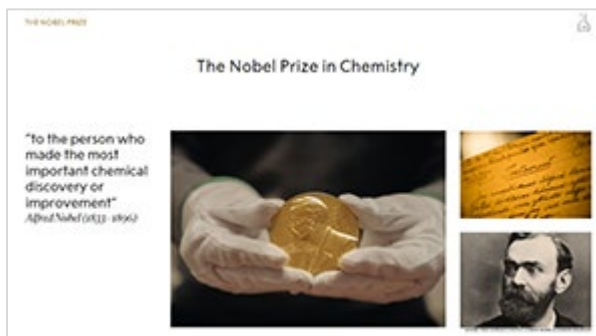


THE NOBEL PRIZE

Speaker's manuscript – Chemistry prize 2025 MOFs – molecular structures

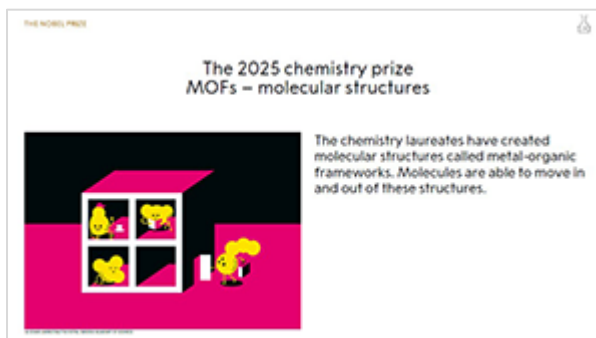
The Nobel Prize in Chemistry

- The Nobel Prize was created by Alfred Nobel. He became very rich due to his invention of dynamite. Before his death in 1896, he wrote in his will that most of his wealth should be used as a prize to “those who, during the preceding year, shall have conferred the greatest benefit to humankind”.
- According to the will, this prize is to be awarded in five categories: physics, chemistry, physiology or medicine, literature and peace.
- The Nobel Prize in Chemistry is awarded “to the person who made the most important chemical discovery or improvement”. In other words, the prize is awarded to people who have provided us with knowledge about the composition of different substances, what atoms and molecules look like, how and why they react with each other – and even how we can create new molecules.



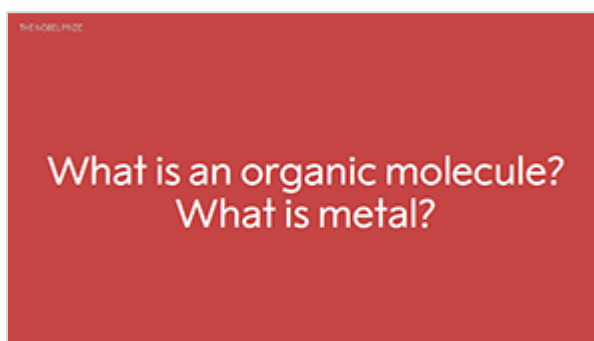
The 2025 chemistry prize MOFs – molecular structures

- The 2025 chemistry prize recognises new architecture at the molecular level.
- The three laureates have created porous materials called metal-organic frameworks (abbreviated as MOFs). MOFs have large cavities that other molecules, such as gases, can move in and out of.
- We will soon take a closer look at how these frameworks work. First, however, you get to think about two terms that are key to understanding the laureates' discoveries.



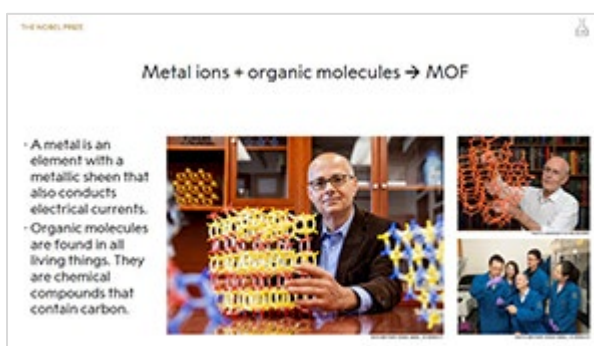
What is an organic molecule? What is metal?

- Discuss two and two: What is an organic molecule? What is metal?
- Suggestions for additional questions: Where are organic molecules found? What atoms characterise organic molecules? What are the properties of metal?



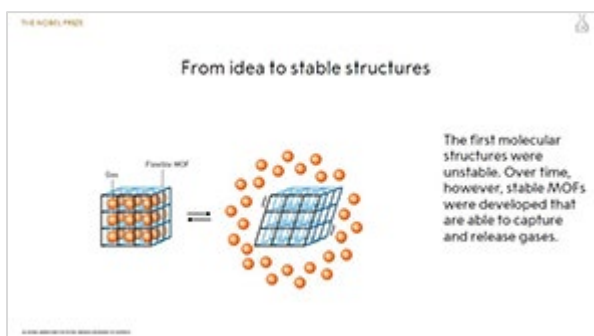
Metal ions + organic molecules → MOF

- A metal is an element with a set structure. In other words, the atoms are located in certain positions. Metals are characterised by having a metallic sheen and are often good conductors of electricity and heat. They exist in nature and are often found in minerals. A metal ion is a metal atom that has lost one or more electrons and thus has a positive charge.
- Organic molecules are chemical compounds that make up all living organisms. They always contain carbon atoms and frequently also hydrogen atoms.
- The chemistry laureates have created a completely new material, MOFs, which are solid and porous. These MOFs are made up of metal ions and organic molecules.
- The metal ions function as cornerstones and are joined together with the organic molecules to become a three-dimensional network. Together, they form regular crystals with large cavities.



From idea to stable structures

- The history of the 2025 chemistry prize begins in Australia already in 1974. While the chemistry teacher Richard Robson was preparing a chemistry lesson, he got an idea. What if it was possible to design new types of molecular structures?
- Ten years later, he decided to test his idea, and a couple of years later, he managed to build a well-ordered airy crystal by using copper ions. The first metal-organic framework had been created.
- This framework was unstable and would easily fall apart, but Robson believed in his idea. He predicted that this material would be useful in the future.



THE NOBEL PRIZE

- The other two laureates later laid a solid foundation for the new molecular structures, and Susumu Kitagawa explored the possibilities of creating hollow structures. The final breakthrough came at the end of the 1990s. He managed to create stable structures where the cavities could be filled with gases, which could then be released.

MOFs that hide huge surfaces in their cavities

- While Kitagawa was experimenting in Japan, Omar Yaghi in the United States started to think about how the material could be created in a more controlled way. He wanted to join together chemical building blocks into large crystals.
- Eventually, he managed to develop a new type of MOFs that were incredibly airy but still very stable. Despite the fact that each MOF was no larger than a sugar cube, the surface in the material's cubic cavity was as big as a football pitch.
- In other words, it resembled Hermione's handbag in the Harry Potter stories. Despite its small size, it can hold almost anything.
- Omar Yaghi also showed how to alter and customise MOFs to give them new and desired properties.



The 2025 Nobel Prize laureates in chemistry

- Richard Robson is a professor at the University of Melbourne in Australia. In an interview in connection with the announcement of the Nobel Prize, he said that many people initially didn't believe in his idea.
- Susumu Kitagawa is a professor at Kyoto University in Japan. He has said that in his work as a scientist, he has followed an important principle – to try to see “the usefulness of useless”.
- Omar Yaghi is a professor at the University of California, Berkeley, in the United States. Yaghi was born in Jordan. His parents were refugees from Palestine. His father finished sixth grade and his mother couldn't read or write. In an interview said:
“It's quite a journey. Science allows you to do it. Science is the greatest equalising force in the world. Smart people, talented people, skilled people exist everywhere. That's why we really should focus on unleashing their potential through providing them with opportunity.”



For the greatest benefit to humankind

- MOFs offer previously unimaginable abilities to customise new materials with new features. MOFs may, for example, be used to capture carbon dioxide from power plants and factories, thereby reducing greenhouse gas emissions, to extract drinking water from the desert air and to store hydrogen.
- Now, let us watch a short video that tells us a little bit more about the discoveries made by the laureates and why they confer the greatest benefit to humankind.

