

Speaker's manuscript – Chemistry prize 2022 It just says click!

The Nobel Prize in Chemistry

- The Nobel Prize in Chemistry is one of the five prizes founded by Alfred Nobel and awarded on 10 December every year.
- Before Alfred Nobel died on 10 December 1896, he wrote in his will that the largest part of his fortune should be placed in a fund. The yearly interest on this fund would pay for a prize given to "those who, during the preceding year, shall have conferred the greatest benefit to humankind."
- The interest would be divided into five equal parts, with one part awarded "to the person who shall have made the most important chemical discovery or improvement".
- The Nobel Prize in Chemistry is thus awarded to people who have made discoveries or improvements that have given us knowledge about the structure of various substances and how they are created and changed.



The 2022 chemistry prize

- People have always been fascinated by the natural world, and chemists have often tried to imitate nature in the experiments they do in the laboratory.
- Nature is good at building complex molecules. Chemists are good at it too, but the methods they use are often difficult, time consuming and expensive.
- This year's laureates have developed new methods of building molecules. Thanks to their work, researchers today can construct molecules in an extremely flexible and efficient way. What was once difficult has now become much simpler.
- The work of this year's laureates can contribute to things like more targeted pharmaceutical cancer treatments and new materials.



The 2022 chemistry laureates

- Barry Sharpless is based at Scripps Research. He coined the term click chemistry in about the year 2000. This is the second time Sharpless has been awarded the Nobel Prize in Chemistry.



- Morten Meldal is a professor at the University of Copenhagen. In 2022 he became the fourteenth Dane to be awarded a Nobel Prize.
- Carolyn Bertozzi works at Stanford University. In 2022, she became the eighth woman to receive the Nobel Prize in Chemistry.

Why do we want to build complicated molecules?

- Complex molecules are the foundation for all life and for the world we live in.
- Complex molecules make up organisms and all kinds of materials. All molecules have important functions.
- Chemists always want to build molecules that have specific properties and that can be used, for example, in different materials, foods or medicines.
- Complex molecules often have to be built in many steps, with each step producing unwanted by-products. These by-products must be removed before the process can continue – a time-consuming and often costly process. For chemists, therefore, it's important to think in terms of sustainability when developing new methods.



The click reaction that changed chemistry

- Working independently of each other and on different continents, Barry Sharpless and Morten Meldal developed a method for constructing complex molecules in an efficient way.
- The researchers already knew that azides and alkynes, which are two kinds of molecules, “snap” together. They click together just like a seatbelt. Click! The laureates’ studies also showed that if we add copper ions to the reaction, they click together faster and more easily, and no unwanted by-products are formed. The result is cleaner.
- The two chemists discovered that we can attach the two important click molecules azide and alkyne to practically any other molecules we want to join together. The process is robust, and chemists can use the reaction as a simple way to combine different molecules. Click reactions make it easier to produce, among other things, new materials that are perfect for their intended use.



Bioorthogonal chemistry illuminates the cell

- Because copper is toxic, many thought it would not be possible to use the click method in living organisms. But the third laureate, Carolyn Bertozzi, discovered a way to do click reactions without copper ions so they could be used in living organisms too.
- Carolyn Bertozzi called these click reactions bioorthogonal reactions. *Bio* means life, and *orthogonal* means the reactants (azides and alkynes) don't react with anything in the biological system.



- By altering the structure of one of the click molecules (the azide), the click reaction became even more efficient. Carolyn Bertozzi also discovered that we can attach a small, fluorescent molecule to one of the click molecules, making it easier to study cells under a microscope. The fluorescent molecules appear green in the picture. The green light allows researchers to study these cells more closely.
- Carolyn Bertozzi's refinement of the click method has thus made it possible for us to use it in living organisms. Today this is a powerful tool for understanding processes in the cell and how biomolecules interact. The tool has begun to be used to develop targeted treatments for diseases.

For the greatest benefit to humankind

- There are many different applications for the methods developed by the 2022 chemistry laureates. Here are a few examples:
 - Efficient production of pharmaceuticals;
 - Targeting pharmaceuticals that can track down cancer tumours;
 - Increased understanding of the progression of a disease, which may eventually make it possible to develop targeted treatments;
 - Production of materials with specific properties that allow them to conduct electricity, capture sunlight or protect from UV radiation.
- Svante Pääbo, who was awarded this year's Nobel Prize in Physiology or Medicine, even used click reactions to analyse DNA remains from Neanderthals.



“When the world is in trouble, chemistry comes to the rescue”

- The quotation comes from a television interview Carolyn Bertozzi gave in conjunction with the announcement of the 2022 Nobel Prize in Chemistry. In the interview, she explains why she believes that chemistry is such an important field. As an example, she mentions Covid-19 and how researchers were able to develop vaccines so rapidly.
- The photo is a selfie taken by Carolyn Bertozzi immediately after learning that she had been awarded the Nobel Prize in Chemistry.

