

Chemical synthesis

In chemistry, **chemical synthesis** (or **combination**) is the artificial execution of useful chemical reactions to obtain one or several products.^[1] This occurs by physical and chemical manipulations usually involving one or more reactions. In modern laboratory uses, the process is reproducible and reliable.

A chemical synthesis involves one or more compounds (known as *reagents* or *reactants*) that will undergo a transformation when subjected to certain conditions. Various reaction types can be applied to formulate a desired product. This requires mixing the compounds in a reaction vessel, such as a chemical reactor or a simple round-bottom flask. Many reactions require some form of work-up or purification procedure to isolate the final product.^[1]

The amount produced in chemical synthesis is known as the *reaction yield*. Typically, yields are expressed as a mass in grams (in a laboratory setting) or as a percentage of the total theoretical quantity that could be produced based on the limiting reagent. A side reaction is an unwanted chemical reaction taking place which reduces the desired yield. The word *synthesis* was first used by the chemist Hermann Kolbe.^[2]

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Many strategies exist in chemical synthesis that go beyond converting reactant A to reaction product B in a single step. In **multistep synthesis**, a chemical compound is synthesized through a series of individual chemical reactions, each with its own work-up.^[3] For example, a laboratory synthesis of paracetamol can consist of three individual synthetic steps. In cascade reactions multiple chemical transformations take place within a single reactant, in multi-component reactions up to 11 different reactants form a single reaction product and in a telescopic synthesis one reactant goes through multiple transformations without isolation of intermediates.

Organic synthesis

Organic synthesis is a special branch of chemical synthesis dealing with the synthesis of organic compounds. In the total synthesis of a complex product it may take multiple steps to synthesize the product of interest and an inordinate amount of time. Skill in organic synthesis is prized among chemists and the synthesis of exceptionally valuable or difficult compounds has won chemists such as Robert Burns Woodward the Nobel Prize for Chemistry. If a chemical synthesis starts from basic