

twelve rules for chemistry that pollutes less, and a scale where familiar materials stop behaving the way bulk matter does



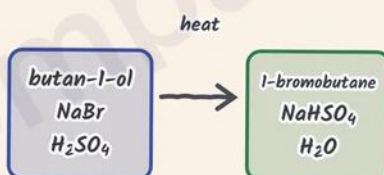
### Green chemistry and sustainable development

- green chemistry : chemistry that prevents pollution by design, not by cleaning up after
- achieved by designing products and processes that reduce or eliminate hazardous substances
- coined by Paul T. Anastas, Yale's Center for Green Chemistry and Green Engineering
- Anastas is called the father of green chemistry
- sustainable development : meets present needs WITHOUT compromising future generations' needs
- achieved by applying the twelve principles of green chemistry
- green chemistry also protects stratospheric ozone and controls the greenhouse effect (global warming)

### Atom economy \*

% of reactant mass that ends up in the desired product

$$\% \text{ atom economy} = \frac{\text{mass of desired product}}{\text{mass of all reactants}} \times 100$$



only the bromobutane is the desired product; NaHSO<sub>4</sub> and H<sub>2</sub>O are the byproduct mass that atom economy counts against

good atom economy means most reactant atoms end up in the product, with only small amounts of unwanted byproduct, so less waste to dispose of

