

## 10.21: The Separation of Mixtures

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When a pure substance is mixed with another pure substance in which it is soluble, the substances become completely interspersed at the molecular level. In thinking about making [solutions at the molecular level](#) an analogy to a can of marbles may be useful. In the analogy, a layer of red marbles is placed in the bottom of a can and covered with a second layer of white marbles. After shaking the can for a short time, the marbles are mixed randomly.

Now let us imagine that you want to collect all the red marbles again. If you simply shake the can, it is unlikely that you will ever divide the marbles into two layers, each with only one kind of marble. Similarly, if two miscible liquids are combined, a chemist cannot simply un-mix the liquids into pure components.

Continuing the analogy, what if a few green marbles and blue marbles are placed into the can? Given enough red and white marbles, it may be difficult to determine that the green marbles and blue marbles are actually there. Similarly, when chemists have a multi-component solution which may contain traces of important chemical species, they are faced with the challenge of detecting whether these chemicals are present in solution.

To deal with these difficulties, chemists employ different methods to separate solutions into their components. Two essential techniques are [distillation](#) and [chromatography](#).

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