The main chromatographic techniques (thin layer chromatography, column chromatography, and gas chromatography) follow the same general principles in terms of how they are able to separate mixtures.

In all chromatographic methods, a sample is first applied onto a stationary material that either absorbs or adsorbs the sample: adsorption is when molecules or ions in a sample adhere to a surface, while absorption is when the sample particles penetrate into the interior of another material. A paper towel absorbs water because the water molecules form intermolecular forces (in this case hydrogen bonds) with the cellulose in the paper towel. In chromatography, a sample is typically adsorbed onto a surface, and can form a variety of intermolecular forces with this surface.

After adsorption, the sample is then exposed to a liquid or gas traveling in one direction. The sample may overcome its intermolecular forces with the stationary surface and transfer into the moving material, due to some attraction or sufficient thermal energy. The sample will later readorb to the stationary material, and transition between the two materials in a constant equilibrium (Equation \ref{1}). If there is to be any separation between components in a mixture, it is crucial that there are many equilibrium "steps" in the process (summarized in Figure 2.3).

\[
\text{X}_{\text{(stationary)}} \rightleftharpoons \text{X}_{\text{(mobile)}} \label{1}
\]

The material the sample adsorbs onto is referred to as the "stationary phase" because it retains the sample's position. The moving material is called the "mobile phase" because it can cause the sample to move from its original position.

The main principle that allows chromatography to separate components of a mixture is that components will spend different amounts of time interacting with the stationary and mobile phases. A compound that spends a large amount of time mobile will move quickly away from its original location, and will separate from a compound that spends a larger amount of time stationary. The main principle that determines the amount of time spent in the phases is the strength of intermolecular forces experienced in each phase. If a compound has strong intermolecular forces with the stationary phase it will remain adsorbed for a longer amount of time than a compound that has weaker intermolecular forces. This causes compounds with different strengths of intermolecular forces to move at different rates.

How these general ideas apply to each chromatographic technique (thin layer chromatography, column chromatography, and gas chromatography) will be explained in greater detail in each section.

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