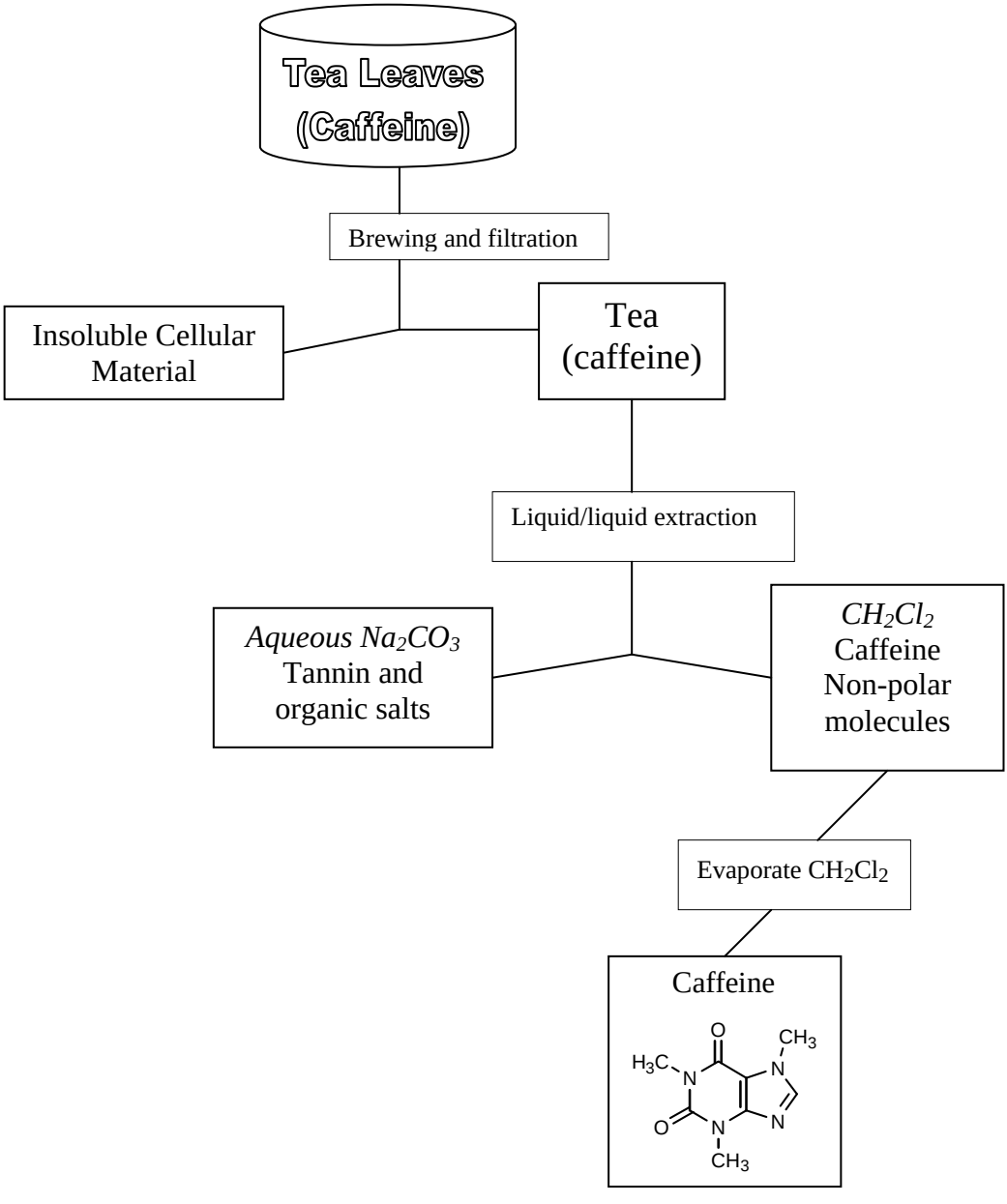
Tea Leaves
(Caffeine)
Brewing and filtration
Insoluble Cellular Material
Tea (caffeine)
Liquid/liquid extraction
Aqueous Na_2CO_3 Tannin and organic salts
CH_2Cl_2 Caffeine Non-polar molecules
Evaporate CH_2Cl_2
Caffeine

Extraction-Overview (Please read Unit 5)

1. Background

By far the most universal and ancient form of extraction is the brewing of tea or the making of coffee. Every pot of coffee or cup of tea involves *solid/liquid extraction,* the extraction of organic compounds from solid ground beans or leaves using hot water as the liquid. The lower molecular weight polar molecules such as caffeine dissolve in the hot water and are removed from the high molecular weight water-insoluble cellulose, protein, and lipid materials. Over 200 compounds, some in only trace quantities, are extracted from the solid into a cup of coffee or tea.

2. Extraction in Organic Lab-Purpose

Liquid/liquid extraction is the most common technique used to separate a desired organic product from a reaction mixture or to isolate an organic substance from its natural source.

The technique works well if your target compound is more soluble in one of two immiscible solvents. Most commonly, one of the solvents is an organic solvent such as methylene chloride (CH_2Cl_2) and the other is water (aqueous). During the semester, and more so next semester, you will need to rely on extraction to separate a compound from a mixture of compounds. Primarily, you will do this to isolate and purify reaction products.

3. Principle-Distribution Coefficient

In the typical example of liquid/liquid extraction described here, the product was a fairly large organic molecule which you would predict to be not very soluble in water. On the other hand, if the product were a lower molecular weight or “small” molecule, you should predict that it might be at least partially water-soluble. Therefore, it might not completely “move” into the organic layer, but also partially dissolve in the aqueous layer. For water-soluble organic materials, such as acetic acid or sugar, most of the solute will reside in the water phase. A quantitative measure of the how an organic compound will distribute between aqueous and organic

phases is called the *distribution or partition coefficient*. It is the ratio, K, of the solubility of solute dissolved in the organic layer to the solubility of material dissolved in the aqueous layer. (Note that K is independent of the actual amounts of the two solvents mixed.)

K= distribution coefficient

$$K = \frac{solubility\ in\ organic\ (\frac{g}{100}mL)}{solubility\ in\ water\ (\frac{g}{100}mL)}$$

The constant K, is essentially the ratio of the concentrations of the solute in the two different solvents once the system reaches equilibrium. At equilibrium the molecules naturally distribute themselves in the solvent where they are more soluble.

Inorganic and water soluble materials will stay in the water layer and more organic molecules will remain in the organic layer. By using the correct solvent system, a molecule can be specifically selected and extracted from another solvent.