# Separating caffeine

***Education in Chemistry***May 2021
https://rsc.li/2QLDAXU

An excellent way to improve your understanding when reading an extended piece of text is to convert the key processes into a series of labelled diagrams or a graphic.

In this activity you will develop this skill by looking at each of the three options for decaffeination in turn and completing graphics of the steps involved in each process.

### 1. Extracting caffeine with organic solvents

a. Add labels to each of the diagrams used to illustrate the step described.

****b. Add in an explanation of why that step is needed. The explanation has been added to Step 1 for you as an example.

**Step 1**

Spray the tea leaves with water.

**Explanation**

*To swell the leaves and open their pores to enable the organic solvent to penetrate them.*

**Step 4**

Caffeine is removed from the solvent by distillation.

**Explanation**

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**Step 3**

The caffeine-laden dichloromethane is driven off the leaves using steam before they are dried to reinstate their original humidity levels.

**Explanation**

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**Step 2**

Shower the humid tea leaves for 1.5–2.5 hours with dichloromethane.

**Explanation**

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**Step 4**

Caffeine is removed from the solvent by distillation

**Explanation**

### 2. Extracting caffeine with supercritical carbon dioxide, CO2

For this extraction option, describe the step illustrated by the diagram and add an explanation of why that step is required.



**Step 1**

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**Explanation**

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**Step 2**

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**Explanation**

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**Step 3**

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**Explanation**

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### 3. Extracting caffeine with water

Using the graphics given above as examples, draw your own graphic to illustrate the steps involved in extracting caffeine from coffee using water.

## Answers

### 1. Extracting caffeine with organic solvents

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**Step 1**

Spray the tea leaves with water.

**Explanation**

*To swell the leaves and open their pores to enable the organic solvent to penetrate them.*

**Step 2**

Shower the humid tea leaves for 1.5–2.5 hours with dichloromethane.

**Explanation**

*To extract the caffeine.*





**Step 3**

The caffeine-laden dichloromethane is driven off the leaves using steam before they are dried to reinstate their original humidity levels.

**Explanation**

*To ensure the tea is free of solvent and caffeine and ready to drink.*



**Step 4**

Caffeine is removed from the solvent by distillation.

**Explanation**

*Separating the caffeine from the dichloromethane means that the dichloromethane can be reused and the caffeine can be purified for use as natural food-grade caffeine.*

### 2. Extracting caffeine with supercritical carbon dioxide, CO2



**Step 1**

*Swell the coffee beans or tea leaves with steam.*

**Reason**

*To enable the solvent to penetrate the beans or leaves.*



**Step 2**

*Place the coffee beans or tea leaves in a high-pressure vessel with CO2 and pressurise for a few hours.*

**Reason**

*To selectively extract the caffeine.*

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**Step 3**

*Pass the carbon dioxide through active charcoal or into distilled water.*

**Reason**

*To remove the caffeine from the CO2 to allow both to be reused.*

### 3. Extracting caffeine with water

Possible steps that could be illustrated include:

**Step 1** Soak the green coffee beans for 8–10 hours in water that has been pre-saturated with all the soluble solids found in coffee beans apart from caffeine.

**Step 2** Dry the beans.

**Step 3** Pass the water through a carbon filter to recover both the caffeine and the aqueous extract for reuse.