

Organic Synthesis: Making Esters

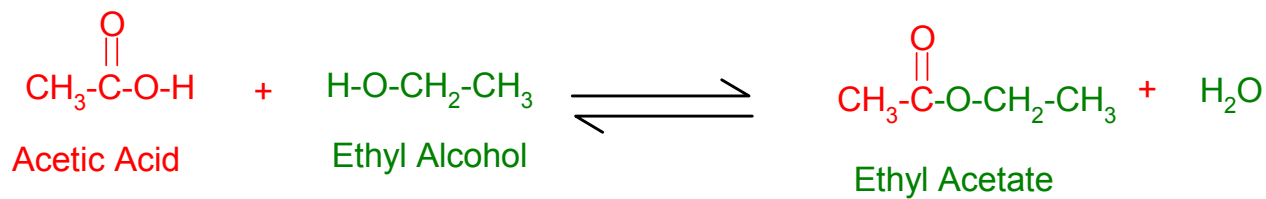
Organic chemistry, the chemistry of carbon and hydrogen containing compounds, has played a major role in society throughout the years. Most of the common drugs used in the medical profession today owe their beginnings to synthetic organic chemistry. Organic synthesis is that branch of organic chemistry that deals with building large, often complex molecules from smaller ones. Today we will synthesize esters.

The general procedure for the preparation of esters involves mixing a carboxylic acid and an alcohol together in the presence of a strong mineral acid such as sulfuric acid. A carboxylic acid that you should be familiar with is acetic acid (vinegar). A common alcohol is ethanol (drinking alcohol). The mineral acid serves as a catalyst to speed-up the reaction.

The Synthesis of Volatile, Fragrant Esters

	Alcohol	Acid
Ester 1	1-pentanol(n-amyl alcohol)	acetic acid
Ester 2	3-methyl-1-butanol (isoamyl alcohol)	acetic acid
Ester 3	1-octanol (n-octyl alcohol)	acetic acid
Ester 4	ethanol (ethyl alcohol)	formic acid
Ester 5	methanol (methyl alcohol)	salicylic acid (solid)
Ester 6	ethanol (ethyl alcohol)	butyric acid
Ester 7	methanol (methyl alcohol)	trans-cinnamic acid (solid)
Ester 8	propanol (propyl alcohol)	acetic acid
Ester 9	butanol (butyl alcohol)	acetic acid
Ester 10	1-pentanol(n-amyl alcohol)	butyric acid

Esters are prepared by a reaction of a carboxylic acid and an alcohol through a condensation reaction, known as esterification.



Esterification reactions are acid catalyzed. They proceed very slowly in the absence of strong acids. We will perform a quick and inefficient synthesis of esters. More care is needed if percent yield and pure material is required. Since our detection method does not require pure material, we can use this form of synthesis.

Procedure:

Place 1 mL of alcohol and 1 mL of acid into a test tube - for the solid acids use a spatula full of material.

1. Carefully, add 3-5 drops of concentrated sulfuric acid.
2. Heat the tubes for 5-10 minutes in a 50-60° hot water bath (use a thermometer to guarantee the proper temperature).
3. After cooling the test tube, add a few drops of 5% Sodium bicarbonate (NaHCO₃) solution to the mixture. (**Caution – this reaction will be accompanied by fizzing and popping**). This will react with any unreacted acid and allow the scent of the ester to be more obvious.
4. Record the smell of the ester on the table below.

Ester 1	
Ester 2	
Ester 3	
Ester 4	
Ester 5	
Ester 6	
Ester 7	
Ester 8	
Ester 9	
Ester 10	