What is Acetyl Coenzyme A?

Acetyl coenzyme A is a thioester derivative of acetic acid 1 (Figure 1). Acetic acid 1 is a typical example of a carboxylic acid and methyl acetate 2 is a typical example of an ester derivative of acetic acid 1. Thioesters are simply the sulphur analogues of esters and compound 3 is a thioester analogue of compound 2. Acetyl coenzyme A is also a thioester and for the moment we will represent it by the abbreviated thioester structure 4 which is the usual way of drawing this molecule.
Figure 5. Acetyl Coenzyme A, Malonyl Coenzyme A, and Malonic Acid

Figure 6. Biotin-bicarbonate complex

Figure 7. Carboxylation of Biotin-BCCP Complex

Figure 8. Formation of Malonyl Coenzyme A

Figure 9. Synchronous Deprotonation-Nucleophilic Attack
Biotin is attached through its carboxyl group to an associated enzyme, biotin carboxyl carrier protein (BCCP) during the carboxylation reaction of acetyl coenzyme A. The mechanism of the carboxylation reaction of acetyl coenzyme A is shown in Figures 7 and 8. The initial reaction involves the carboxylation of the biotin-BCCP complex with bicarbonate giving molecule 9 as shown in Figure 7.
How is Acetyl Coenzyme A used in Biosynthesis?

In Figure 11, the reaction mechanism has been shown as a stepwise reaction involving the formation of a discrete carbanion intermediate. In reality, a synchronous reaction occurs; as carbon dioxide is lost carbon-carbon bond formation takes place as shown in Figure 12.

Intermediates 11 are used widely as precursors to a diverse range of natural products. We shall see later how fatty acids and polyketides are biosynthesized from intermediate 11.