SMC3 is an essential gene that encodes a member of a ubiquitous family of chromosome-associated ATPases. SMC proteins are found in eukaryotes, prokaryotes, and archaea, and appear to play roles in chromosome dynamics. In eukaryotes, SMC proteins form two kinds of heterodimers, corresponding to Smc1p-Smc3p and Smc2p-Smc4p in yeast. The Smc1p-Smc3p heterodimer interacts with additional proteins, including Mcd1p and Irr1p, to form the yeast cohesin complex, which is required for sister chromatid cohesion in mitosis and meiosis. Smc3p is acetylated by Eco1p during S-phase and remains acetylated through G2/M. This acetylation is required for sister chromatid cohesion. The yeast cohesin complex associates with centromeres and other discrete sites along chromosome arms prior to metaphase; the association with centromeres requires the centromere protein Mif2p, the centromere binding complex CBF3, and Cse4p. Scc2p is not a stoichiometric cohesin subunit, but is required for the cohesin complex to associate with chromosomes. Conditional lethal mutations in SMC3 cause premature dissociation of sister chromatids. Homozygous smc3-42 diploids fail to sporulate and are defective in synaptonemal complex formation. Cohesin complexes that include homologs of Smc1p and Smc3p have been identified in other eukaryotes, including Xenopus, C. elegans, S. pombe, and human. SMC protein homodimers have been found in prokaryotes.