The Sm and Sm-likeproteins are a highly conserved family of ancient origin, found in bacteria, archaea, and eukaryotes. These proteins were first characterized in humans with systemic lupus erythemathosus, where autoantibodies were found that recognize an antigen called Sm. The Sm antigen was characterized as a domain present in a group of eight small proteinsthat associated with four of the five snRNAsinvolved in splicing of nuclear pre-mRNAs. The S. cerevisiae genome contains 16 proteins containing an Sm, or Sm-like, domain. Seven genes encode proteins corresponding to the human Sm antigen proteins: SMB1, SMD1, SMD2, SMD3, SME1, SMX3, and SMX2. An additional eight genes, LSM1, LSM2, LSM3, LSM4, LSM5, LSM6, LSM7, and LSM8 also encode proteins containing Sm domains and are thus named LSMproteins. These proteins are more closely related to individual Sm proteins than to each other. MAK31 has also been reported to contain an Sm domain.Crystal structures of human Sm proteins, in pairs or with U1 snRNA, indicate that the seven core Sm proteins form a heteroheptameric ring with a small central hole. The Sm site, the conserved uridine rich sequence found near the 3-prime ends of the U1, U2, U4, and U5 snRNAs, appears to form contacts along the inner surface of the ring complex and it is suggested that the RNA may pass through the hole. Experiments in S. cerevisiae indicate that a similar seven-membered ring containing one copy of each of the seven Sm proteins exists in yeast. Similarly to the Sm proteins, the Lsm proteins also form heteroheptameric rings. In S. cerevisiae, as well as in other eukaryotes, two different Lsm ring complexes exist, containing Lsm2p-7p and either Lsm1p or Lsm8p.The Sm ring complex is required for the biogenesis of the U1, U2, U4, and U5 snRNPs and also has additional functions during splicing of nuclear mRNAs. Depletion of a single Sm protein, e.g. Smd3p, decreases total levels of U1, U2, U4, and U5 as well as the amount of these snRNAs which have been processed to contain the normal trimethyl cap structure. Similarly, destroying the Sm binding site in an snRNA also prevents proper processing and capping of the snRNA. It is not yet clear whether the snRNAs are exported to the cytoplasm for assembly into snRNP complexes, as occurs in mammalian cells, or whether the snRNA remains in the nucleus and the Sm ring complex is imported into the nucleus to bind with the snRNA. Tgs1p associates with the SmB protein of the Sm ring to hypermethylate the snRNA cap structure, a process which occurs in the nuceolus. The Sm ring complex remains associated with the snRNA as part of the core of each snRNP, each of which contains additional specific proteins.The Sm ring complex is also associated with the telomerase template RNAand appears to be involved in biogenesis of the telomerase enzyme in yeast. After the RNA subunit is transcribed, capped, and polyadenylated, binding by the Sm ring complex to an Sm site in the 3' region of the TLC1 RNA appears to be required for further processing, including removal of the polyA tail and hypermethylation of the cap. As in the case of the spliceosomal snRNPs, it appears that the Sm complex remains associated with the telomerase RNA in the active holo-telomerase enzyme.