A 3-connected matroid $M$ is said to be \textit{minimally 3-connected} if, for any element $e$ of $M$, the matroid $M\setminus e$ is not 3-connected. Dawes (\textit{J. Combin. Theory Ser. B} \textbf{40}, (1986), 159-168) showed that all minimally 3-connected graphs can be constructed from $K_4$ such that every graph in each intermediate step is also minimally 3-connected. Oxley (1981) proved a similar result by giving a characterization of minimally 2-connected matroids. In this paper we generalize Dawes’ result to minimally 3-connected binary matroids. We give a constructive characterization and construction of all minimally 3-connected binary matroids starting from $W_3$, the 3-spoked wheel, and $F^*_7$, the Fano dual. (Received September 26, 2005)