We define a new class of a rank-3 matroid called a trilateral matroid. The ground set of such a matroid consists of the points of an $n_3$-configuration, and the bases of the matroid are the point triples corresponding to non-trilaterals within the configuration. We classify which $n_3$-configurations induce trilateral matroids, and provide several examples of those that do. (Received September 19, 2015)