In this paper, we introduce a large-scale 3D erasure network, where n wireless nodes are randomly distributed in a cuboid of $n^{\lambda} \times n^{\mu} \times n^{\nu}$ with $\lambda + \mu + \nu = 1$ for $\lambda, \mu, \nu > 0$, and completely characterize its capacity scaling laws. Two fundamental path-loss attenuation models (i.e., exponential and polynomial power-law models) are used to suitably model an erasure probability for packet transmission. Then, under the two erasure models, we introduce a routing protocol using percolation highway in 3D space, and then analyze its achievable throughput scaling laws. It is shown that, under the two erasure models, the aggregate throughput scaling $n^{\min\{1-\lambda,1-\mu,1-\nu\}}$ can be achieved in the 3D erasure network. This implies that the aggregate throughput scaling $n^{2/3}$ can be achieved in 3D cubic erasure networks, while $\sqrt{n}$ can be achieved in 2D square erasure networks. The gain comes from the fact that, compared with 2D space, more geographic diversity can be exploited via 3D space, which means that generating more simultaneous percolation highways is possible. In addition, cut-set upper bounds on the capacity scaling are derived to verify that the achievable scheme based on the 3D percolation highway is order-optimal within a polylogarithmic factor under certain practical operating regimes on the decay parameters.