Convex polyhedra are familiar objects. Cubes and pyramids are common in all kindergartens. Polyhedra, in their high-dimensional versions, are widely used in applied mathematics. Their beauty and simplicity appeal to all, but very few people know of the many easy-to-state but difficult-to-solve mathematical problems that hide behind their beauty. This lecture introduces the audience to some fascinating open questions on the frontiers of mathematical research and its applications.