Hyperbolic geometry, discovered in the 19th century, is a non-Euclidean geometry with constant negative curvature. Tessellations in hyperbolic geometry are usually presented in the Poincare Disk model. Unlike in Euclidean geometry which only has 3 possible regular tessellations, there are infinity many possible different tessellations in the hyperbolic plane. The goal of this research is to find a genus 2 surface of fixed area (4π) that has maximal systole. Hyperbolic geometry can be used as a tool in the research because it is the natural geometry on surfaces of genus greater than or equal to 2 (g ≥ 2). Each surface corresponds to a tessellation of the hyperbolic plane/disk. This geometric optimization problem has potential applications in many fields, such as materials and biomedical engineering, when designing the most efficient valves. Some findings of the research are listed below: Genus 2 surfaces can be represented as octagons in the hyperbolic plane; there are different ways to represent genus 2 surfaces and transformations between these representations; Genus 2 surfaces can be represented by the gluing pattern of 12341234 or 12123434, and they can be transformed to each other by the process of cut and paste; the Bolza surface that follows the gluing pattern of 12341234 (glues each side to its opposite side to form a genus 2 surface) is the surface that has the local maximum systole.