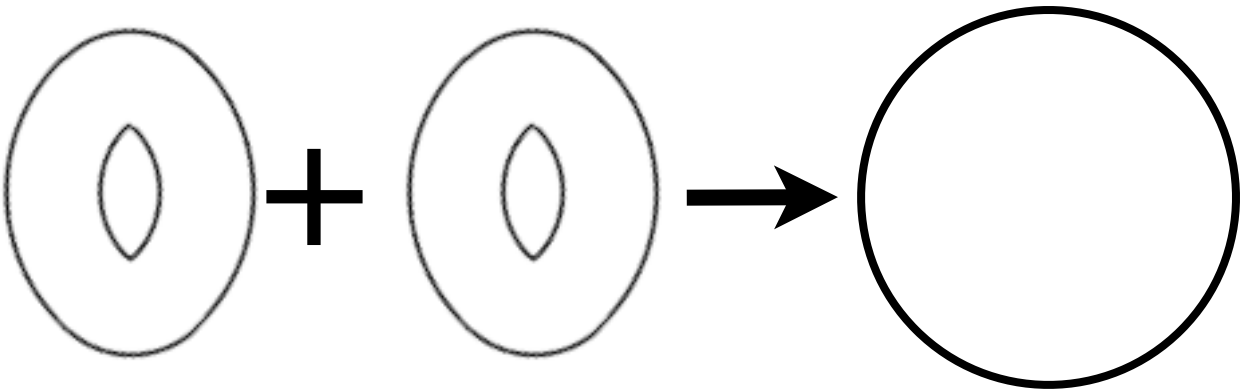
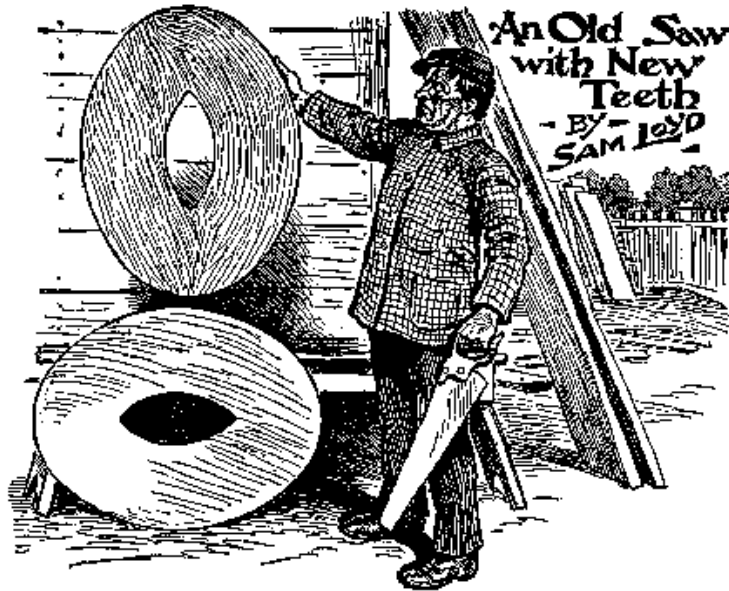
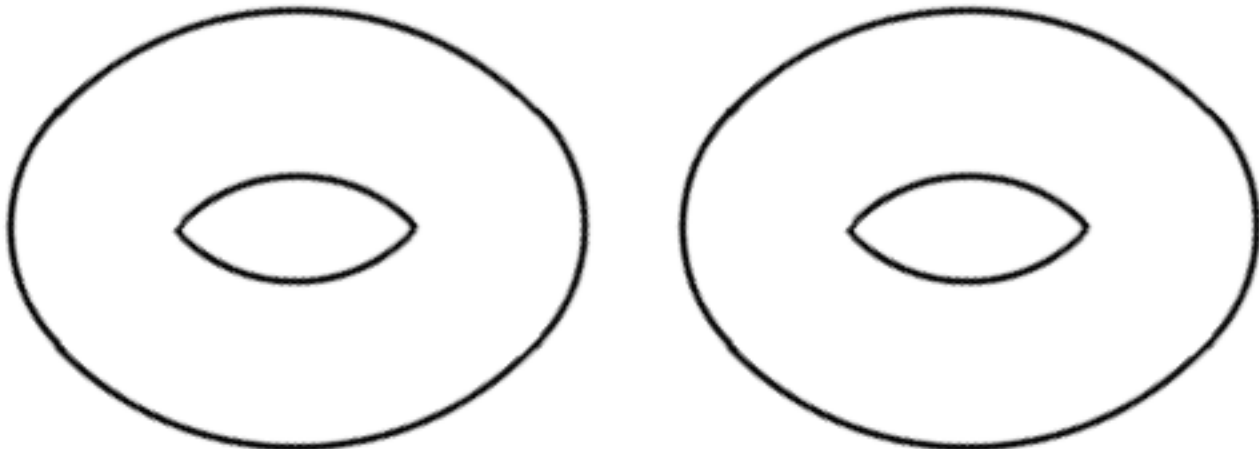


An Old Saw With New Teeth (Sam Loyd)

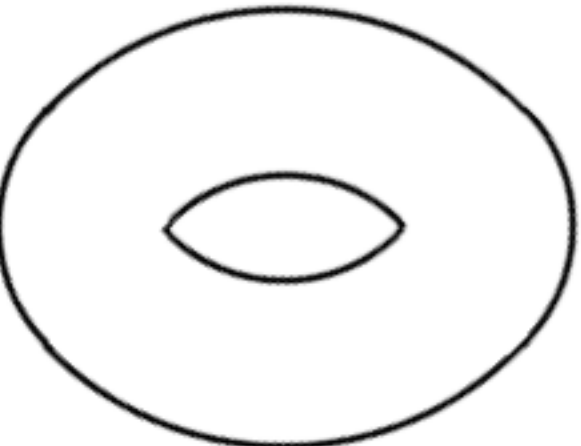
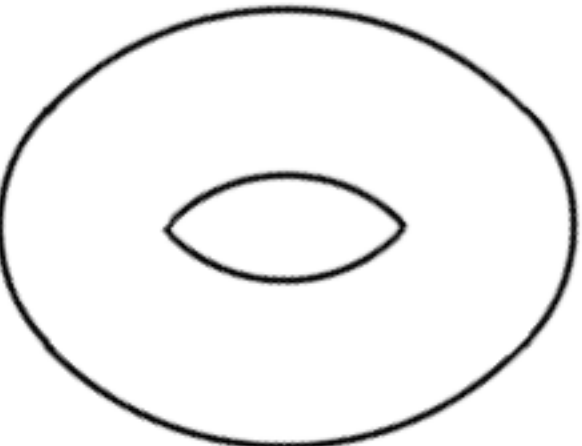
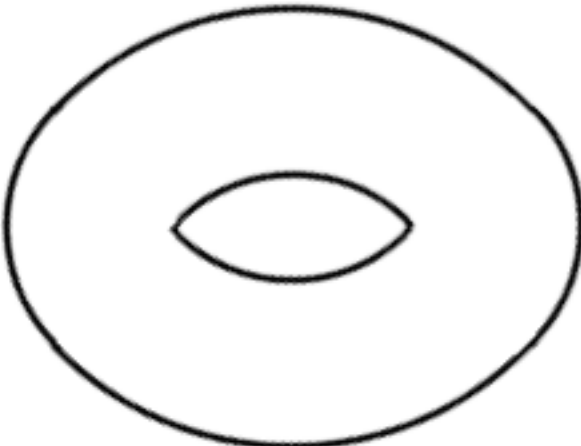
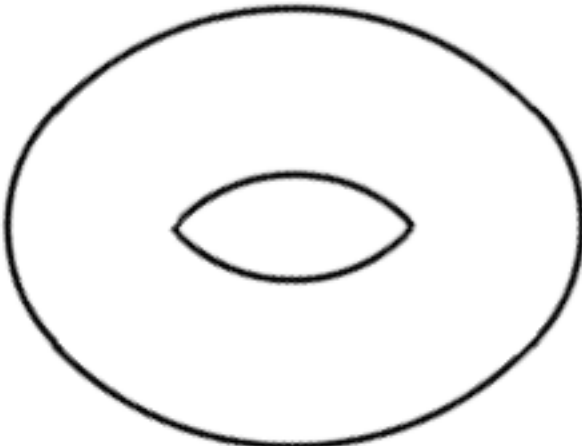
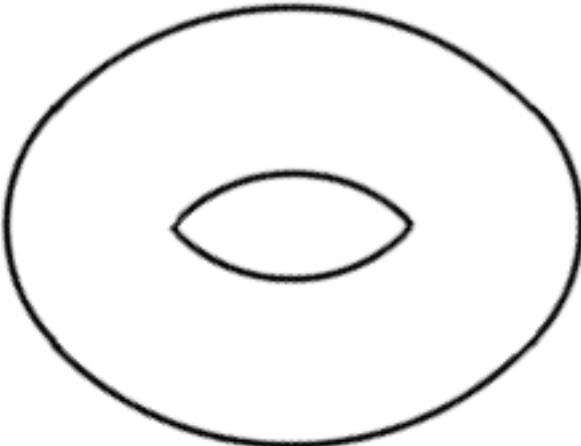
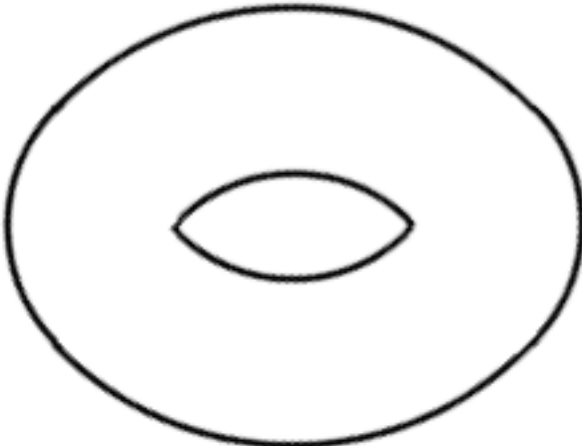
Proposition: Divide the two ovals shown below into the fewest number of pieces that will fit together and form one large circular piece.



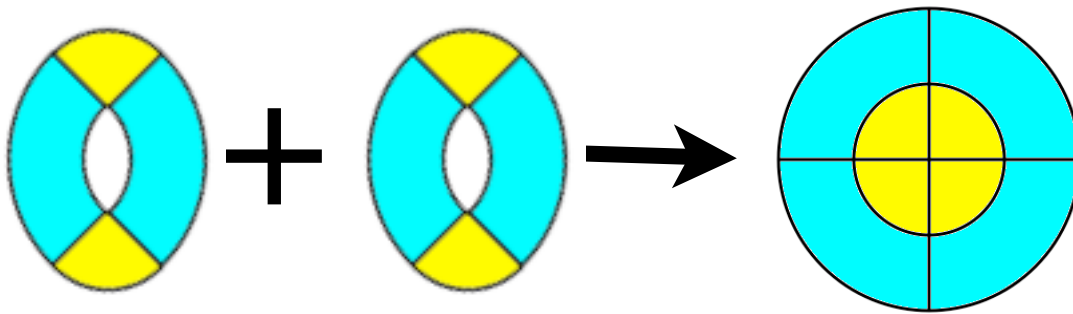
Cut out the 2 ovals below. Draw lines on the ovals that might divide the ovals into the required parts. Cut out the parts and fit them together and form one large circular piece.



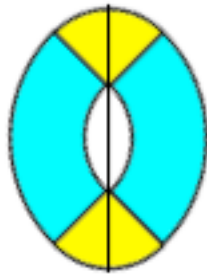
Extra Ovals



Solution:



The best way to see the exact dimensions that make up the 4 parts of each oval is to start with the circle. The large circle has a radius of 2 units, A second concentric circle with a radius of 1 unit is drawn. A vertical and horizontal diameter are drawn as shown above. This creates 4 yellow parts and 4 blue parts. The solution makes it easy to see how the 4 parts of each oval fit together.



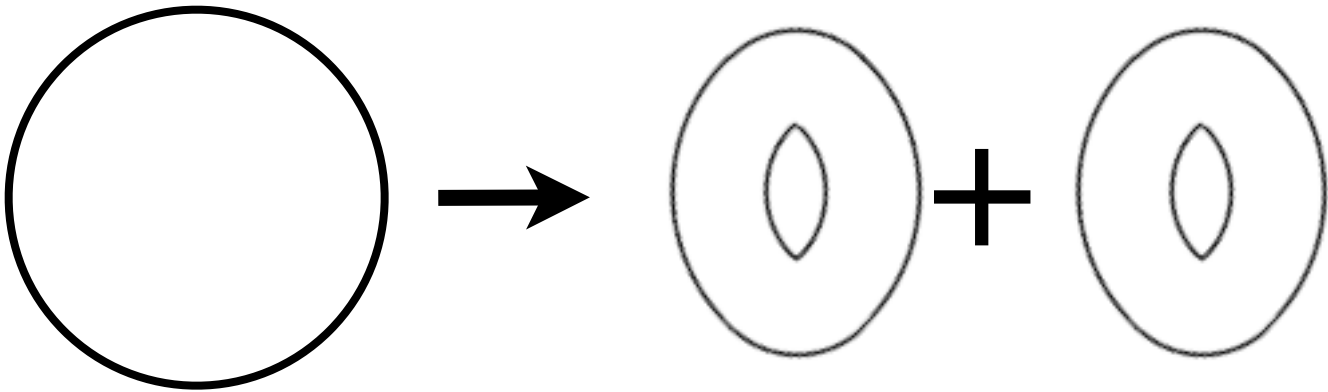
How to divide the ovals:

Place the oval with the long dimension vertical as shown. Draw a line for the long center axis of the oval. From the point where the axis intersects the top end of the opening inside the oval draw a line segment from the point of intersection to the edge of the oval so that it creates a 45 degree angle. Do the this on both sides of the long axis at both the top and bottom points where the axis intersects the top end of the opening inside the oval .

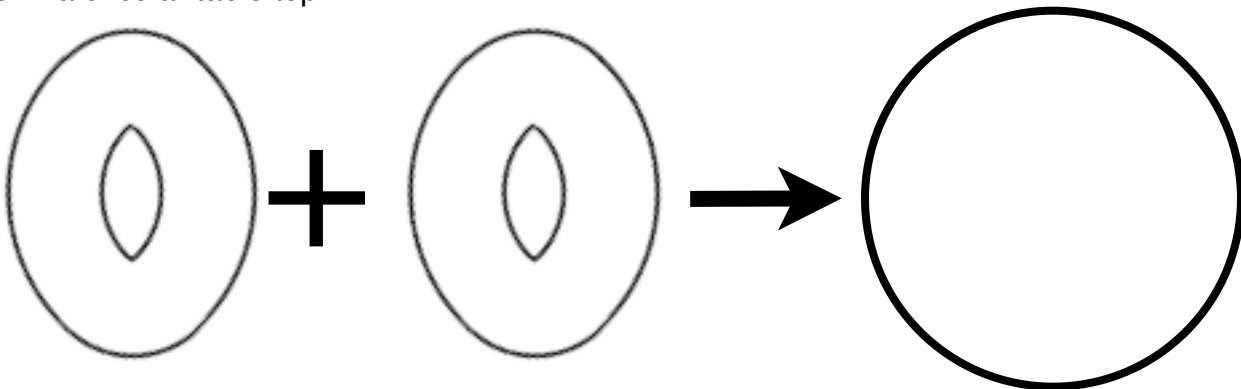
Do the same thing to the second oval. You now have 8 parts. Place the 4 yellow parts together to form a circle. The remaining 4 blue parts will surround the yellow circle and form a larger circle.

The History Of This Puzzle

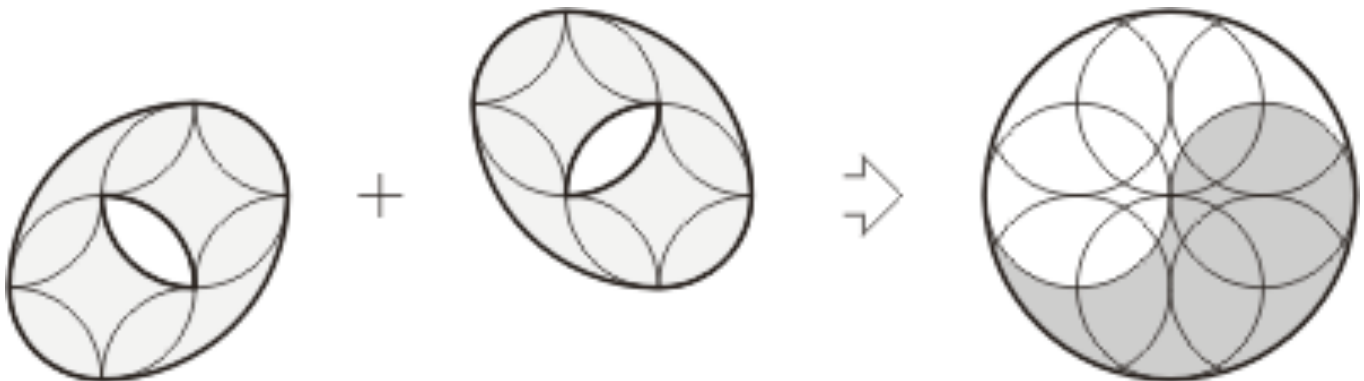
This well-known, classic puzzle with transformation of two oval stools into a circular table top has long and interesting history. More than 180 years ago, in 1821, John Jackson posed in his book *Rational Amusement for Winter Evenings* a puzzle how to transform a circle into two hollow ovals as shown below, and proposed an 8-piece solution.



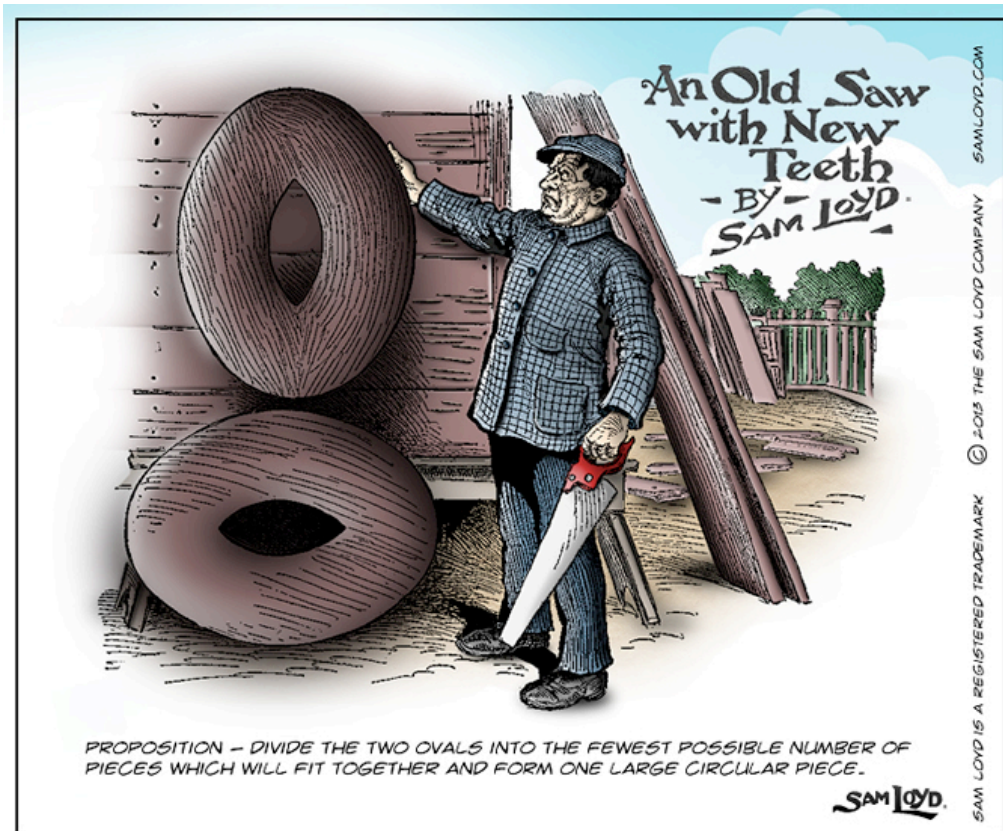
Then, at the beginning of the 20th century this puzzle attracted attention of Sam Loyd, who was the greatest America's puzzle creator. In Loyd's legendary *Cyclopedia of 5000 Puzzles, Tricks & Conundrums*, the puzzle was posed under the name "An Old Saw with New Teeth" as a challenge how to dissect two ovals with an oval hole in each of them into the fewest number of parts which can form a circular table top.



Loyd published it as a contest, showing then a better, 6-piece solution which was based on a famous Great Chinese Monad pattern. Try to find that 6-piece solution using as a hint that pattern and patterns depicted on two ovals and on the resulting circle as shown in in the illustration below. Keep in mind that diagrams shown in the illustration contain all necessary lines to make your cuts, but not every of these lines you will need to use, though.



Loyd's Version



Almost every collection of puzzles contains a certain problem wherein it is told how a joiner who had a circular board wished to convert it into two oval tabletops with holes in the centers. The puzzle is to cut the circular piece into the fewest number of pieces which will form the two ovals, but as the shape of the ovals are not given, the puzzle is generally looked upon as too difficult and unsatisfactory.

By the modern plan, however, which is to reverse the problem and work it backwards, the terms may be turned around so as to make a presentable, up to date puzzle, and is given as an instructive lesson in puzzle building.

Divide the two ovals into the fewest possible number of pieces which will fit together and form one circular piece, like the top of a table without any hole in it.

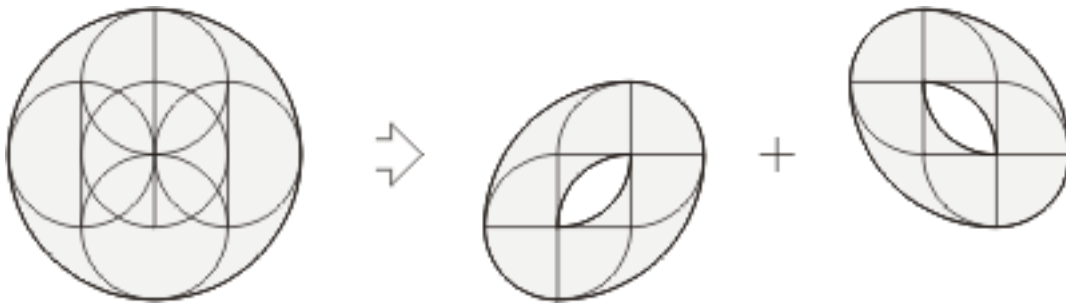
Of course you can follow the old style if you prefer it. Take a perfect circle and divide it into the fewest number of pieces which will fit together and form two oval rings as with holes in them, but remember to put a strong accent upon the "fewest number of pieces."

Recent Discoveries

In 1997 Greg Frederickson, the world's expert in dissection puzzles, published an outstanding book on history and achievements in this old and comprehensive field of recreational math, *Dissections: Plane & Fancy*. Chapter 15 in that book is fully devoted to dissections with curved figures, and also describes the above and some other variations of the puzzle with two hollow ovals. In the book Greg shows quite different, novel 6-piece solution to Jackson's ovals.

Since the first publication of Jackson's puzzle there were numerous attempts to improve the 6-piece solution to the puzzle. Finally, in March of 2004 several new solutions were presented. There was a new 6-piece solution, two basic solutions containing just five(!) pieces each, more than a dozen of different modifications of these basic 5-piece solutions, and proofs that in math sense there is an infinite number of 5-piece solutions. In every of them one piece is flipped over. Finding any of 5-piece solutions is not an easy task, so try to discover one of the simplest of them. Could you do this? Hint. The diagrams below contain all necessary lines to make your cuts. Of course, not all of them are needed to be used for this. And keep in mind that in a 5-piece solution one piece is allowed to be flipped over.

Diagram for 5-piece solution.

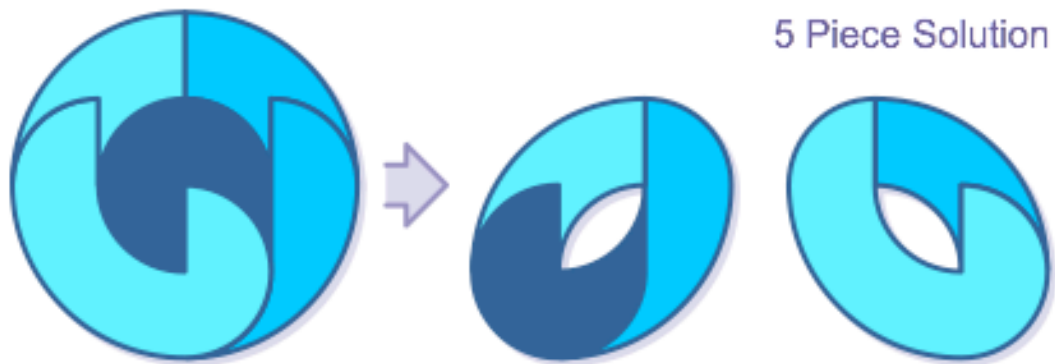
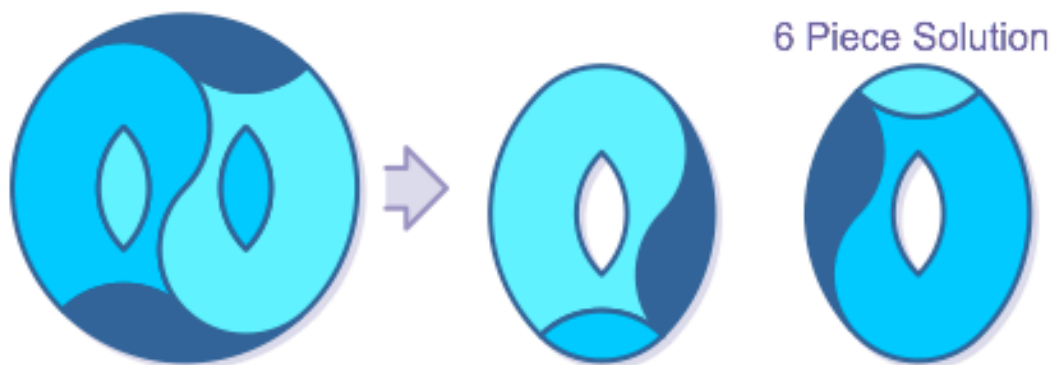
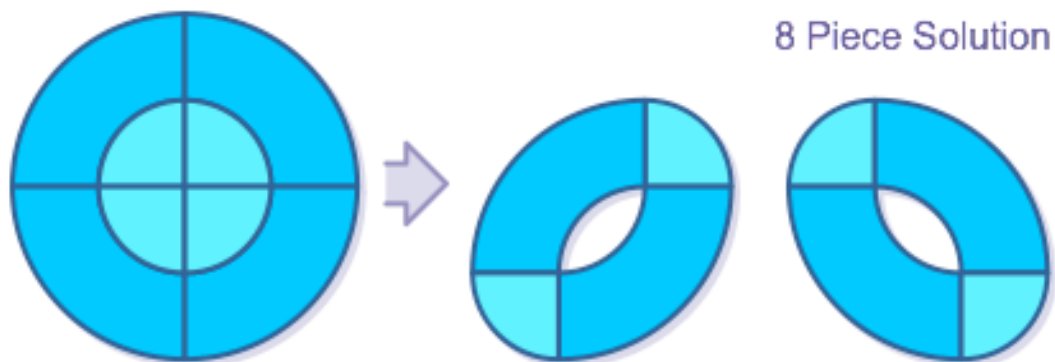


Last but not least, there is a variation of the hollow-ovals-to-circle puzzle posed by Sam Loyd in his attempts to find solution with the least number of pieces. It also is based on the Great Chinese Monad pattern described above, and you can easily solve it keeping in mind that every oval is divided in exactly two the same pieces. The illustration below shows this Loyd's variation and all necessary lines to make you cuts. Again, please remember that you will need just some of these lines to cut both ovals.



Loyd's variation with four pieces.

In March 2004, Serhiy Grabarchuk proposed an improvement on Sam Loyd's 6-piece dissection of a disk to two oval seat tops. Serhiy's dissection uses only five pieces, though one is turned over, as we see below.



It isn't often that someone comes up with an improved solution for a dissection problem that's been around for almost two centuries, as Serhiy Grabarchuk has done. Serhiy Grabarchuk was born in 1958 in Uzhgorod, Ukraine. He earned a degree in the instruments of fine mechanics from the Kiev Polytechnic Institute, Kiev, Ukraine in 1981. From 1981 to 1989, he worked in several Ukrainian industrial design offices as an engineer-designer, and from 1981 to the present he has been working as a professional puzzle designer and writer. Serhiy creates, designs, collects, solves, makes, produces, and publishes puzzles and puzzle collections. He has created several thousand different puzzles, many of them produced around the world. (See his website Puzzles.com.) He is also captain of the Ukrainian Puzzle Team, and represents Ukraine in the World Puzzle Federation. In addition to puzzles, Serhiy enjoys performing magic and puppet shows.