

The Golden Dividers

Cardboard kit for dividers to determine the Golden Ratio

465.GZK

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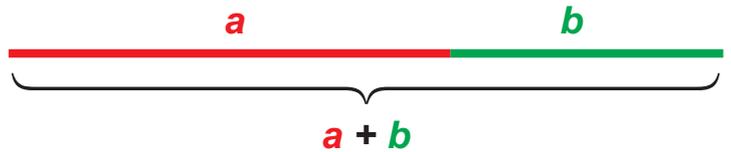
The Golden Dividers were invented in 1893 by the physician and painter Adalbert Goeringer. They are an ingenious and practical tool to find the Golden Ratio in nature, artistic works, photographs, or drawings.

The Golden Ratio denotes a certain ratio between two parts of a distance, angle, or area that is perceived as especially harmonious. To find this ratio, divide a distance into two parts a and b , so that the ratio between a and b is the same as the ratio between $a+b$ and a (a being the longer part). The resulting lengths a and b can then be divided again following the same rule and so forth. The number that is given by this ratio is called φ in geometry and its numerical value is 1.6180339887.... Basically it means a is about 1.618 times longer than b .

The Golden Ratio φ is an irrational number, which means that it cannot be written as the ratio of two integers because it has an infinite number of decimal places that don't repeat.

The value of φ is closely related to the Fibonacci Sequence [0,1,1,2,3,5,8,13,21,34,55,...] in which you add the last two numbers to find the next one in the sequence. If you divide two consecutive numbers of the Fibonacci Sequence you will get a result that gets closer and closer to the correct value of φ , the higher up the sequence you go. For example $8/5=1.6$, $13/8=1.625$, ..., $55/34=1.61765$, etc.

The Golden Ratio has been known since ancient Greece, its first written definition is in Euclid's script *Elements*. It can be found in numerous classical and modern buildings, from the Parthenon in Athens to Le Corbusier's Villa Stein in Garches, Paris. A large number of classical and modern paintings make use of the Golden Ratio, too. It can also be found in nature: proportions in animals and humans, plants, even down to the internal structure of DNA, the Golden Ratio is ubiquitous! A short internet search will result in a wealth of information about the Golden Ratio.



$$a : b = (a + b) : a$$

Contents:

- 2 sheets of 0.5mm construction cardboard
- 4 barrel bolts 5 x 6mm
- 3 pointed wooden sticks, 2mm

You will also need for assembly:

- * Standard solvent based all purpose glue, e.g. UHU, Evo-Stik Impact, B&Q All Purpose Glue. **Do not use water-based glue:** it softens and warps the cardboard, and doesn't stick properly to the printed surfaces. Solvent based glues also dry much faster.
- * A piece of sand paper or a file to chamfer the wooden tips.
- * A ruler to measure the length of the wooden tips.
- * A flat head screwdriver for the barrel bolts.
- * A sharp knife with a fine point (thin carpet knife, craft knife, scalpel), to cut the thin holding tabs of the pre-punched parts and to shorten the wooden tips.
- * A cutting board or mat, made from hardboard, plastic, or wood. Self healing cutting mats are ideal as the material re-closes after each cut.
- * Optional: a golden lacquer pen to paint the white edges of the legs.

Tips for successful construction Please read before commencing!

- * The Golden Dividers consist of four main parts: The upper and lower main legs, the golden leg and the cross link. The cross link makes sure that the golden leg always divides the distance between the main legs according to the Golden Ratio.
- * The assembly itself is quite straight forward. The four main parts are constructed from 6 layers of cardboard, which makes them nearly as sturdy as wood laminate. The parts are denoted [A] to [D], their six layers are also carrying the numbers 1 to 6, e.g. [A1] or [C5].
- * Places needing glue are marked in grey. On each of these grey areas you will find a part number followed by an arrow in a square: **B5** \rightarrow \square . The number denotes the part that will be glued in this place.
- * The points of the three legs are made from wooden sticks and are glued into square recesses inside the ends of the legs.
- * Make sure that all layers are glued exactly flush on top of each other. It is a good idea to push their edges carefully onto the worktop before the glue sets to accomplish this.

Building Instructions

A. The Upper Main Leg

Step 1: Remove the six parts [A1] to [A6] from the cardboard and open the holes in all of them. Also open the slits at the ends of the grey parts [A2] to [A5].

Step 2: Glue [A1], [A2], [A3], [A4], and [A5] exactly flush on top of each other, as indicated by the glue marks. The slits in the grey parts now form a 25mm long and 2mm wide groove. Do not glue on part [A6] yet!

Now we will prepare the point of this leg from one of the wooden sticks. The sharp end of the stick should be rounded slightly to prevent injuries.

Step 3: Take one of the sticks and draw its end at an angle over a piece of sand paper while twisting the stick at the same time. This way you can round off the tip until it is blunt enough to be safe. Alternatively you can just cut off a piece of the tip using a sharp knife.

Step 4: Cut off exactly 30mm from the blunt end of the stick and test its fit in the groove of the leg. The tip of the stick should stand out exactly 5mm. The projecting length of exactly 5mm is important to ensure precise operation of the finished dividers. If necessary you can shorten the stick a bit more or pull it out slightly. Now glue the wooden tip into the groove, again checking for the correct length before the glue sets.

Step 5: Finally glue part [A6] on top of the leg.

The upper main leg is now finished.

B. The Lower Main Leg

Steps 6 to 10: The lower main leg is constructed in exactly the same way as the upper main leg. Follow Steps 1 to 5 again, replacing the part numbers A with B.

C. The Golden Leg

Steps 11 to 15: The golden leg is constructed in exactly the same way as the other two legs. Follow Steps 1 to 5 again, replacing the part numbers A with C.

D. The Connecting Link

Step 16: Glue the six parts [D1] to [D6] exactly flush on top of each other as indicated by the glue marks.

E. Final Assembly of the Golden Dividers

Step 17: Put the round ends of the main legs on top of each other and connect them with a barrel bolt.

Step 18: Pull the two legs apart, lay the dividers on the table as in the picture below and, using a barrel bolt, connect the round end of the golden leg to the underside of the main leg that lies on top.

Step 19: Finally fit the connecting link to the other main leg and the golden leg with the last two barrel bolts, as shown in the picture below. Open and close the dividers a few times and check their accuracy with a ruler: If the tips of the main legs point to 0mm and 161.8mm, then the golden leg should point exactly to 100mm.

Congratulations!

You have finished the construction of your Golden Dividers. Now you are the owner of a beautiful and accurate instrument that will help you find and explore the Golden Ratio in a large variety of objects.



✱ AstroMedia Schweiz ✱

Postfach 427, CH 4143 Dornach
info@astromedia.ch, www.astromedia.ch