



## Tutorial

# Popcorn Screw

... how to build an Archimedes screw in 7 easy steps!

### You need:

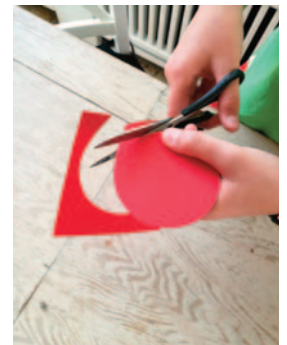
a round plastic bottle  
 ½ sheet of construction paper  
 a wooden stick,  
 approx. 40 cm long and 0.5 cm  
 in diameter (shaft)  
 a cutter, ruler, and a pair of  
 compasses  
 scissors, pencil, and a stapler  
 some wood glue  
 popcorn



**Step 1:** Carefully cut a triangular opening in the upper third of the bottle with a craft knife or scissors. (see picture). Then cut off the bottom of the bottle.



**Step 2:** Measure the diameter of the bottle with the ruler. Half of this is the radius, the exact width to which you set your compass. Draw seven circles with it on the construction paper and cut them out.



**Step 3:** Now outline a circle as thick as the wooden stick in the center of each of your cut out circles. Then cut out these smaller circles as well.

**Step 4:** Staple the circles together so that they form a spiral. Staple one end of the circle to the opposite end of the circle below.



**Step 5:** Slide the paper circles onto the stick and carefully pull them apart.

**Step 6:** Tape the top and bottom ends of the spiral to the stick. Also, crimp an edge into each end of the spiral. The edge should touch the wall of the bottle so that the popcorn does not slip through later.

**Step 7:** Now insert the spiral into the bottle, dip it into the bowl of popcorn and start turning the stick (shaft). The popcorn will now be transported upwards piece by piece.

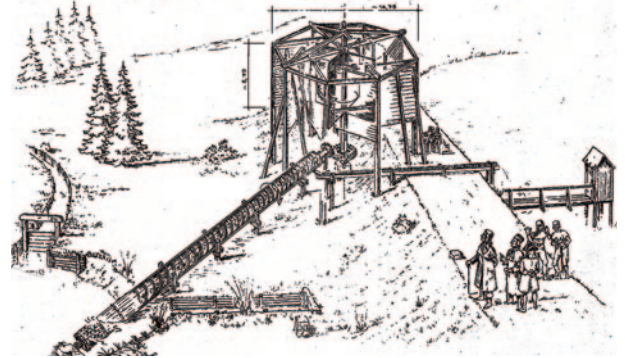




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# The Archimedean Screw

Back in the 3rd century BC, Archimedes, the Greek mathematician and engineer, was already making use of spiral-shaped screw pumps, which is why they were named after him. They are also known as screw conveyors because they were used to transport water to a higher level, i.e. vertically from the bottom to the top. Archimedean screws were also used early on to drain the land in the Netherlands.



Drawing: H. J. Boyke. With permission Foundation World Heritage Harz.

## Windmills in mining

Gottfried Wilhelm Leibniz also invented technical machinery. Mining was a high-tech industry in the 17th century, and for the dukes of Hannover, silver from the Harz mines was a lucrative source of income. Leibniz gave a lot of thought to improving silver mining in the Harz Mountains. One of his ideas was to make use of the Archimedes' screw: water was an important source of energy in mining, because it moved the large wheels that powered the machines. Leibniz came up with the ingenious idea of recycling water after use. He collected water that had already run over the large wheels in pools and transported it back up to the water wheels with the help of Archimedean screws driven by windmills.

## Leibniz's 'horizontal wind art'

Leibniz invented a special windmill for this purpose which he called 'horizontal wind art'.

Because the blades of the windmill were arranged horizontally inside a ring of rigid guide screens, the wind could enter the windmill from all sides to move the blades. A very useful feature, as it meant that the windmill did not have to be turned into the wind.

By combining the horizontal windmill and the Archimedean screw, Leibniz wanted to save water in the Harz Mountains. This was a very progressive idea because water was scarce in the Upper Harz. Nevertheless, the machines needed to be powered so that mining – the people's livelihood – could continue. In the 17th century, all energy was generated by water, wind, or muscle power.

