

# The Magnetic Egg Timer

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## How do egg timers work?

Traditionally egg timers are small hourglasses. These were invented around 150 B.C., but were then forgotten for a long time. Only in the Middle Ages did they finally make a comeback. Contrary to common belief, hourglasses were not filled with sand. Sand would be much too coarse and the grains would be too unequal in size. Apart from dust made from marble, lead, or zinc, people mainly used finely ground and sieved egg shells as a filling. Nowadays hourglasses and egg timers are usually filled with tiny glass beads. The main factor for the proper functioning of an hourglass is the ratio between the diameter of the opening in the middle and the diameter of the grains: The hole should be at least twice as large and at most 12 times as large as the diameter of the grains. The grains move much slower through an hourglass than they would through an opening the same size in an open container. The explanation is simple: the air displaced by the grains in the lower bulb of the hourglass has to move upwards into the other bulb at the same time as the grains fall through. This air movement slows the grains down significantly.

## What is so special about my Magnetic Egg Timer?

Inside a normal egg timer the grains will always form a shallow conical mound in the lower bulb. The new grains then fall onto the tip of the cone before they slide down the side. If you put your Magnetic Egg Timer onto its wooden stand, something completely different happens: although the grains fall through the hole as usual, they form a spiky, hedgehog-like structure at the bottom of the lower bulb. Only when you lift the egg timer off its stand, the spiky structure disappears and turns into the normal cone.

## How is that possible?

The first secret: There is a small but very powerful neodymium magnet inside the wooden stand of your egg timer. Obviously this magnet influences the grains inside the glass, which reveals the second secret: the grains are not made from glass beads, but from a very fine cast iron granulate that reacts to the magnet.

## What causes the hedgehog-like structures?

Magnets have two poles (“north” and “south”) and are surrounded by a magnetic field. You can imagine this field like a bunch of lines of force that exit the magnet at one pole, form an arc, and then enter it again at the other pole. The magnetic field is the strongest next to the poles, as that is where the density of field lines is the highest. Opposite poles of two magnets attract each other, whereas equal poles of two magnets produce a repellant force between them. If a grain of iron is placed inside a magnetic field, it temporarily becomes magnetic itself. The grain then is attracted by the magnet in the base, aligning itself along a magnetic field line. But that is not all! Each magnetised grain instantly attracts others that also align themselves along the field lines. This is the reason that they form the hedgehog-like structure and not the usual cone when they fall into the lower bulb of the egg timer. Each of the spikes consists of a row of magnetised grains which have oriented themselves along a magnetic field line, each north pole touching the south pole of the next grain. But since equal poles repel each other, the grains forming one field line will push away the ones forming another, while trying to keep contact with the pole of the magnet in the base at the same time. This way the resulting structure resembles the bunch of magnetic field lines that extend from the magnet into the lower glass bulb of your Magnetic Egg Timer.