STEMBOT

Co-funded by the
Erasmus+ Programme
of the European Union

Studying the strength of the shell of a chicken egg

Key words

- Forces;
- Motion;
- Physics;

The science behind

The egg is perhaps one of science's most amusing and mysterious objects of study. Its shell is the subject of many scientific experiments, and it can illustrate concepts relating to resistance, pressure, inertia, etc.
Different and fun experiments can be achieved in the classroom to help you better understand these concepts. However, the best investigation is consistently the one that challenges our questions. For example, can one egg hold the weight of a book? So how many eggs does it take to maintain the weight of an encyclopaedia? Does an egg break every time it falls? How high can it fall without breaking? Can I build something to protect the egg from falling from the first floor?

There are so many questions that the best thing to do is to collect all the materials, eggs, and "hands-on" tests. An egg, depending on the strength of its shell, can support a certain weight on top of itself. However, if the weight is too much, the eggshell will not hold. If more eggs are placed under that same weight, the pressure applied by the object will be distributed among all the eggs.

Let us perform some calculations!

Suppose an egg can support a maximum weight of 50g on top of itself, and an encyclopaedia weighs 500g. So, since 500g is more than 50g, we can say that the egg will break easily with the weight of the encyclopaedia. However, what is the scenario if we place the encyclopaedia on top of 12 perfectly aligned eggs? Will the result be different?

In an ideal scenario, the weight will be distributed over the 12 eggs like this: 500g / 12 eggs = 42g per egg (approx.) As 42g is less than 50g, then we can say that yes, the eggs will easily bear the weight of the encyclopaedia!

Another way to study the strength of the eggshell is to throw it on the ground. What do you think will happen? Will it break?

To drop an egg on the ground without breaking sounds impossible, right? What if I tell you it is not?!

The goal is simple! To build something, from simple objects, that prevent an uncooked egg from breaking when dropped from different heights. To do this, you need a better understanding, practically, of the effect of gravity and air resistance on objects. Let's explain:

There are three basic ways to increase the probability of dropping an egg safely:

Reduce the speed of descent. Parachutes are an obvious method of slowing the speed of descent, provided the design includes a way to keep the parachute open.

Cushion the egg so that something other than the egg itself absorbs the impact of landing.

The largest end of the egg has an area of air trapped between the two membranes of the egg. This airspace forms when the contents of the egg cool and contract after the egg is laid. It is responsible for the crater often seen at the end of a boiled egg. After impact, the heavier spherical yolk continues to move towards the ground. The compression of the airspace acts as an air sack for the valuable contents of the egg. The construction of an artificial cushioning device will also help absorb the impact of the landing.

It orients the egg so that it lands on the strongest part of the shell. The arched structure at both ends of the egg is stronger than its sides. Pressure is distributed down (or up) the arches so that less pressure acts on any one point. Orienting the arches downwards will increase the survival of the egg.

If we can build something that absorbs the shock, then the egg will survive without a single crack.

So, what is the best way to protect the egg?

Well, all three ways are good!

Build something with these 3 factors in mind and test your egg from different heights.

Everyday life

In our everyday life, we can find different applications of this concept.

One of the most famous examples of applying these concepts is the airbag in cars.

This technology uses the same principles.

In the event of an accident, there is a significant impact. At that moment, the airbag, together with the other safety accessories, tries to reduce the speed of the effect using the belt, for example, and to absorb the impact through the airbag.

If you think about it, what automotive engineers do is precisely the same as what you did in this experiment—trying to create devices that ensure that nobody inside the car "breaks" on impact.

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Project code: 2021-1-FR01-KA220-SCH-000027775