

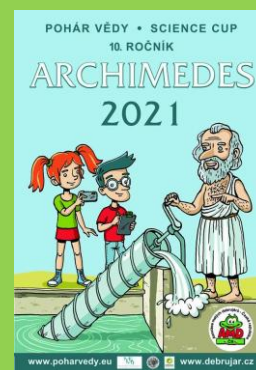
# SCIENCE CUP – ARCHIMEDES 2021



## POHÁR VĚDY SCIENCE CUP

Category 4 – High School

1<sup>st</sup> round – January – deadline 15. 2. 2021 23:59



## Introduction

Dear competitors, welcome in the first round of the 10<sup>th</sup> year of the Science Cup – ARCHIMEDES 2021. Before you start working, please spend some time on this information on tasks, solutions, and evaluation.

Every month's assignment includes creativity task (40 % of the total evaluation), and practical task (60 %). The solution procedure of individual tasks should be described with your own words and documented with your own photos or pictures.

For assignment solution, you are given 45 days in the first and second round, and 30 days in the third round. The solution must be handed in latest on given deadline day before 23:59, when the assignment is closed.

The solution must be uploaded to the Science Cup web interface in the given period as one file in PDF format, not exceeding 10 MB in size. All the content of the solution (texts, drawings, schemes, photos) cannot exceed 4 pages of A4 paper format, and should be easily readable (simple font, minimal font size 11 pt.).

We can imagine you can write and fill with pictures far more than only four pages. The judges, however, need to have the possibility to read and fairly evaluate all the solutions. Thus, all the solutions that would not meet the given criteria would get, unfortunately, -20 points as penalization. On the contrary, if your solution gets full marks, you can get 40 points for creativity and 60 points for practice. In total, you can reach to 100 points in each of the three rounds of the corresponding part of the competition. Each evaluation consists also from the written feedback, so you know what your strong part was, and what you can improve for the next rounds. For the evaluation, the work of the team, not of the team leader, is crucial.

Last, but not least, please be aware of one innovation. For your presentation during the final, your team would have ONLY a table or a school desk of approx. 100 x 150 cm in size (exact size will be given in the acceptance letter for the finalists) and the proximate surroundings of 10 cm around the table. You would not be able to use any additional space (walls, notice boards, floor behind the 10-cm radius), so keep this in mind when preparing your products.

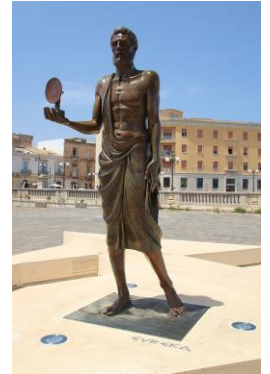
Now you can start working, good luck with the tasks and enjoy the exploring!

Yours ARCHIMEDES 2021 Team – Jit'a 1, Katka, Jit'a 2, Nad'a, Andrea, Igor, and David

# 1. Creativity and idea (40 %)

Archimedes studied the laws of mechanical equilibrium, and thus founded the statics of solids. He defined a number of important terms, such as **center of gravity** or static moment. He dealt with the principles of operation of simple machines - levers, pulleys, inclined planes, wedges, and gears and discovered and formulated the laws of their balance.

The point where the gravity acts is called the **center of gravity** (the original name *center gravitatis* - center of mass). Each body has a single center of gravity. If the weight distribution of the body does not change, nor does the position of its center of gravity. The position of the center of gravity is determined by the distribution of the substance in the body. The center of gravity can be outside the body (e.g. with a bent wire, etc.)

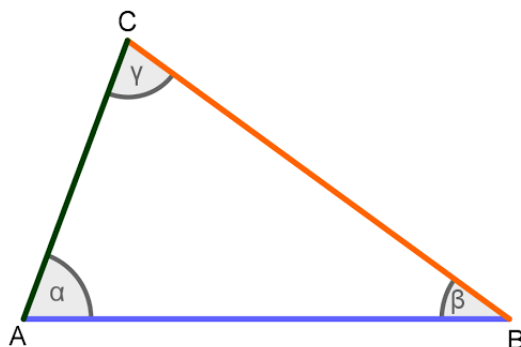


Bronze statue of Archimedes (Eureka) in Syracuse  
picture downloaded from: <https://cs.wikipedia.org>

1. Use **at least five and at most eight** common kitchen / household utensils (e.g. forks, knives, ladles, glasses, skewers, water, string, corks, CDs, pencils, etc.) and introduce us to your "Center of Gravity Statue" - an interesting system with a suitably located center of gravity so that the system is stable.

Name your "Center of Gravity Statue", write down how many and what aids you used, document the statue with photographs or pictures and, of course, do not forget the physical explanation.

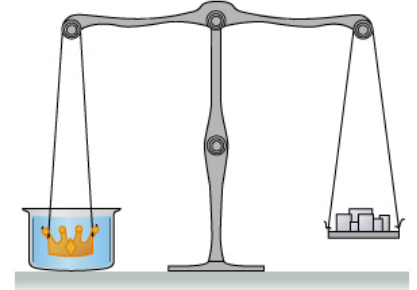
2. Mark the **position of the center of gravity** of the bodies in the figures:



## 2. Practice and project (60 %)

Archimedes is also considered the founder of hydrostatics. He investigated floating and hydrostatic buoyancy. He understood the meaning of the term **density**, formulated it precisely and probably found a method of measuring it by double weighing. He formulated the Archimedes' law.

**Density** is a physical quantity that expresses the mass per unit volume of a substance. The density of a homogeneous body is given as the ratio of the weight of the body and its volume. The unit of density in the SI system is  $\text{kg} \cdot \text{m}^{-3}$ , sometimes the unit  $\text{g} \cdot \text{cm}^{-3}$  is also used.



Golden Crown of King Hieron II.  
picture downloaded from: <https://notendur.hi.is>

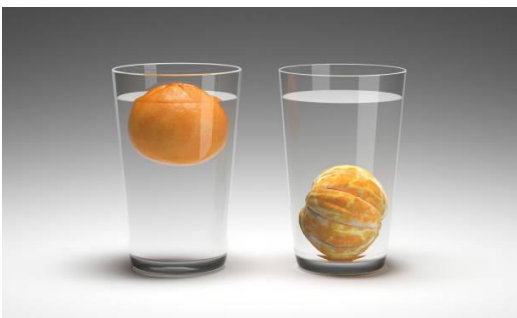
1. Do your research in a kitchen again. Try to be like Archimedes and explore the density of different liquids or examine the behavior of bodies in a liquid. Introduce us **to two experiments of your choice**.

Describe the necessary tools, the experimental process, and the results of the **two experiments**, including correct and complete explanation. Complete your work with the results of your measurements or observations and with your own photos or your own pictures.

2. Estimate whether the boiled egg has the same, higher or smaller density than the raw egg and suggest a procedure for verifying your hypothesis.

Determine the density of both eggs - again describe the necessary tools, document the procedure with photographs or pictures and provide also your measurement results.

In the first round, we will again give you at least a few photos as a hint for the first task:



pictures downloaded from: <https://www.sciencebuddies.org/>

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Describe the solution procedure of each task, the results of your team work, and any additional information, and document them with photos.

The solution can be handed in only before the deadline. Only the solutions fulfilling all the requisites given in the propositions will be judged without any point loss.

If you have any questions, you can ask a category consultant in your country:

Czech Republic: Jitka Soukupová – [jitule.sk@seznam.cz](mailto:jitule.sk@seznam.cz) and Nad'a Zíková – [zikova@icpf.cas.cz](mailto:zikova@icpf.cas.cz)

Turkey: Basriye Öngel – [basriye.korkmaz@gmail.com](mailto:basriye.korkmaz@gmail.com)