

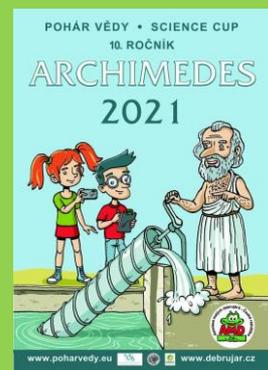
# SCIENCE CUP – ARCHIMEDES 2021



## POHÁR VĚDY SCIENCE CUP

Category 2 – Primary 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'aS, Jit'aH,,Katka, Nad'a, Andrea, Igor, and David

# 1. Creativity and idea (40 %)



Archimédes, Photo:  
<https://cs.wikipedia.org>

*The Greek scholar Archimedes, who gave name to this year's Science Cup, studied a number of different physical phenomena and constructed many different ingenious devices. He also dealt with balance and center of gravity.*

Take a pencil or a pen and place it horizontally on your finger so that it does not immediately fall. The place under which it is best to support the pencil can be found by placing the pencil on two fingers to support it at the edges. Slowly slide one finger toward the center of the pencil, and the pencil begins to tilt. Slide the other finger toward the center of the pencil to re-align the pencil. Gradually slide both fingers to the center so that the pencil always straightens. Once your fingers touch each other, you have found the desired place – if you support the pen in this place, you can hold the pen horizontal and it would not fall.

Find the center of gravity of an ordinary pencil and the center of gravity of a pen. Borrow a large wooden spoon and find its center of gravity. Can you find the center of gravity of a broom? Try to find the center of gravity of some other interesting things. Draw the researched objects and their centers of gravity and describe how you searched for the center of gravity.

If we support the object under the center of gravity, it will be in balance and will not fall. However, the center of gravity does not always have to be inside the body or the system of bodies, sometimes it can lie outside them (for example as in the figure in the picture).

Find the answer to the question on what (on what quantity) the location of the center of gravity in the body depends.

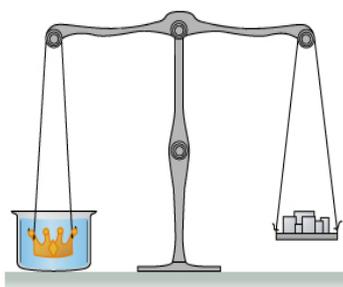
Use **at least four and at most eight** common kitchen / household utensils (e.g. forks, knives, ladles, glasses, skewers, water, string, corks, CDs, pencils, etc.) and make your "**Center of Gravity Statue**" - an interesting system with a suitably located center of gravity so that the system is stable. For inspiration you can watch: [https://www.youtube.com/watch?v=A8mubIj9xnQ&feature=emb\\_logo](https://www.youtube.com/watch?v=A8mubIj9xnQ&feature=emb_logo)

Name your "**Center of Gravity Statue**", write down how many and what aids you used, and document the statue with photographs or pictures.



Center of gravity rope  
walker  
Photo: J. Houšková

## 2. Practice and project (60 %)



Golden Crown of King Hieron II.  
Picture: <https://notendur.hi.is>

Archimedes is also considered the founder of hydrostatics. He investigated floating, understood the meaning of the term **density**. 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.

Do your research in a kitchen again. Try to be like Archimedes and explore the density of different liquids. Examine 1) various liquids and 2) the same liquid with various temperatures. You can alter the liquid also by adding salt or sugar.

Density determines how individual liquids "stack" on top of each other. The lower density liquid will be above the higher density liquid. For example, in an oil-water pair, there will be oil, that has a lower density than water, on top of the water (greasy eyes float on the soup). You can also change the density of the liquid by salting or sweetening it.

Hint: You can color individual differently heated or differently flavored liquids, for example with food coloring (it has a very small effect on the density). You can then observe the differently colored liquids well.



pictures from: <https://www.stevespanglerscience.com/> a <https://www.exploratorium.edu/> and by Jitka Houfková

When examining the density of different liquids, first estimate which liquid you think is the least dense and which is the most, compare your estimate with the result of your research - was the liquid you find the most dense, at the lowest place in your test tube - so it had the highest density? Can you find a liquid for which that doesn't work?

When examining the density of a differently heated liquid, answer the question whether and how the temperature of the liquid is related to its density.

Introduce us **to two experiments of your choice**.

Describe the necessary tools, the experimental process, and the results of the **experiments**, including correct and try to explain the principles of the experiments. Complete your work with your own photos or your own pictures.

Document your experiments with photographs and pictures, and write everything down carefully. We suggest you make research diaries, in which you will write and draw everything. You will not send us the diaries, but if you are promoted to the finals, you will take them with you together with the products from the individual rounds.

**But don't forget that in order to be able to judge all your solutions at all, what you send us must not exceed four pages!**

We are looking forward to your solutions and see you in the next round!

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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 Houfková – [jitka.houfkova@gmail.com](mailto:jitka.houfkova@gmail.com) and Kateřina Vágnerová – [Katerina.Vagnerova@seznam.cz](mailto:Katerina.Vagnerova@seznam.cz)

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