# Slovene Science Competition for young students

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**Abstract.** A science competition for primary school students Kresnička, organised annually since the school year 2014/2015 by The Society of Mathematicians, Physicists and Astronomers of Slovenia is presented. A format of the competition is explained and some basic data about participants is given. An example of experiment and competition problem related to the experiment is shown.

**Keywords:** science, competition, primary school.

## INTRODUCTION

In a long tradition of various competitions in knowledge for primary school students in Slovenia (many of them derived from the times of Yugoslavia - in 1965 the first competition in mathematics was organised and in 1981 the first competition in physics was organised) we recognised few years ago there was a gap in the field of science. An idea of science competition based on experiments was adopted from similar Polish competition [1], but already in the first run transformed and developed away from their model [2,3]. The most important reason for introducing a new science competition was popularisation of science and its experimental methods in particular, among primary school students and their teachers. In short, we provide ideas and instructions for science observations or experiments which could enrich regular school lessons if conducted in school environment and also instruments for testing the goals of experiments; competition problems. There is only one - the school - level of the competition, which makes the competition unique compared to most of other competitions, which end at national level. In science students compete only in the group of their schoolmates and we believe some stress is removed from teachers' shoulders due to this.

Various reasons, among them also reputation of DMFA Slovenije and our competitions among Slovene teachers and solid support of our internet based information service contributed to immediate reach of wide population of primary school teachers and students. We detect a steady growth of the number of participants since the beginning. We believe we have found a form of competition which functions well at different aspects and activates teachers as well.

## OBJECTIVES AND PARTICIPANTS

For students in the last 2 or 3 grades of primary school (of altogether 9 grades) there are more competitions in knowledge than there are school subjects, and some of them are not related to school subjects at all: there are few competitions in mathematics, a competition in logics, physics, astronomy, chemistry, biology, geography, Slovene language, English language and many more. For younger students there are less competitions, and there was a gap in science. We introduced Kresnička for students of the first 7 grades (from the 1st to the 7th, with students' ages between 6 and 12) and successfully filled that gap.

The science competition is related to school subjects with integrated science contents: in the first triade (grades from the 1st to the 3rd) science is integrated into the subject *Learning about the Environment* (the name of the subject literally translated) with 3 hours of lessons per week. In the next two grades there are 3 hours of lessons per week of the subject named *Science and Technology*. In the 6th and 7th grade there are 3 and 2 hours of lessons per week for the subject *Science*. In the last two grades of the primary school the science disintegrates into three science disciplines: biology, chemistry and physics with 2 hours of lessons per week per each of the three science subjects [4].

The first science competition Kresnička was organised in school year 2014/2015. In Table 1 there is data about participants and participating schools since then [5]. There are approximately 450 primary schools in Slovenia and an average generation recently amounts to approximately 20 000 persons. Popularity of competition grows, as can be understood from increasing number of participants, participating teachers and schools.

**TABLE 1.** Numbers of involved students, teachers and schools in the first four competitions [4].

| School year | Participants | Schools | Mentors | Involved teachers |
|---|---|---|---|---|
| 2014/2015 | 9138 | 222 | 949 | 1166 |
| 2015/2016 | 15064 | 260 | 1569 | 1891 |
| 2016/2017 | 16227 | 284 | 1823 | 2114 |
| 2017/2018 | 17663 | 311 | 1992 | 2325 |

On the other hand, when we look into details of Fig. 1 we see that we have substantial growth in the first triade, moderate growth in the 4th and the 5th grade and no growth - but stable number of participants in the 6th and 7th grade. We definitely feel the need to encourage chemistry and biology teachers of sixth- and seventh-graders to bravely participate in Kresnička in larger numbers.

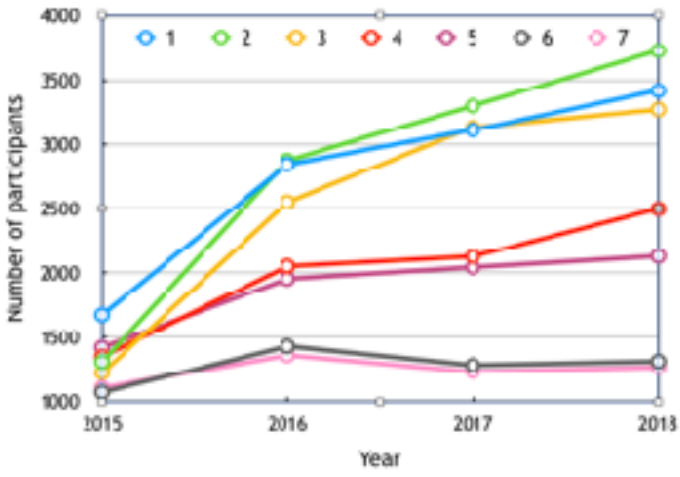


**FIGURE 1.** Number of participants of the competition from different grades (from the 1st to 7th) grew (mostly) in the following years.

## FORMAT OF COMPETITION

Students of 7 grades are divided into 4 age groups. In the beginning of the school year instructions for three science experiments for each age group are published on our web pages [2,3]. We aim to propose a truly science experiments, where science disciplines (biology, chemistry, physics and also astronomy) are integrated and a phenomenon is perceived from different aspects, if possible. The experiments should meet also other criteria: no sophisticated equipment should be needed to perform them, accessories are common objects, available and cheap. Students should be able to perform them independently, by themselves, also at home, with no or minor assistance of their teachers. Time spent at experimenting should not be too long and should be adapted to abilities of young students.

Instructions for experiments consist of two parts. In the first part the instructions for the basic steps come through two cognitive channels telling the same: they are written, short and explicit and they are also illustrated with a sequence of camera pictures. Even if a young student has a poor reading literacy he should be almost able to grasp the idea of experiment from the pictures alone. In the second part of the instructions there are several additional questions, aiming to stimulate recognition of patterns and detecting correlations in observed phenomenon, linking sometimes abstract and isolated phenomenon from experiment to the real life phenomena, and there are also some suggestions for variations of experiment. Instructions for all experiments from the last competition can be found in [2] and experiments from the past competitions are available in [3].

Students should perform the experiments in school or at home before the competition. The competition takes place before the winter holidays. At the competition the students solve theoretical problems, which are all related to phenomena, observed at experiments. The most difficult problems check if patterns in observed phenomena or experiments were detected and underlying rules were recognised.

After the competition all the problems and solutions to the problems are published on the web, to complete the educational resources, offered to teachers. All resources we provide are open and freely available for potential future use in school, see *Arhiv* at [3]. Selected experiments, problems from competition, corresponding to particular experiment and results from competition are described in references [6-11].

We should explicitly mention that we do **not** provide the information about expected outcomes of experiments nor give any detailed explanations for the phenomena. Not all outcomes of experiments can be foreseen. Even we do not always know in advance what will happen exactly. This is sometimes the difficult part for the teacher: he should descend from his throne of somebody who knows and rather join as equal to his students on their joyful path of wondering, discovering the patterns and correlations.

## AN EXAMPLE OF EXPERIMENT: COLLISION OF COINS

One of the three experiments for students of the 4th and the 5th grade in the school year 2016/2017 had a basic physics content: collisions. The experiment was a common game, usually played with marbles, but in order to make the outcomes of collisions easily observable marbles were replaced with coins. In the basic variation of experiment there were two coins, a target coin and a projectile coin. For the largest part of experiment the central collisions were observed, while masses of the two coins could be equal or not. Figs. 2 and 3 show excerpts from instructions: a flick of the projectile coin in Fig. 2 and target coins with different masses (in this

case all larger from the mass of the projectile coin) in Fig. 3. At the end of the instructions few more complex variations of experiment were suggested, including non-central collisions and targets, assembled from two or more coins, as shown in Fig. 4 (resembling the Newton's cradle).

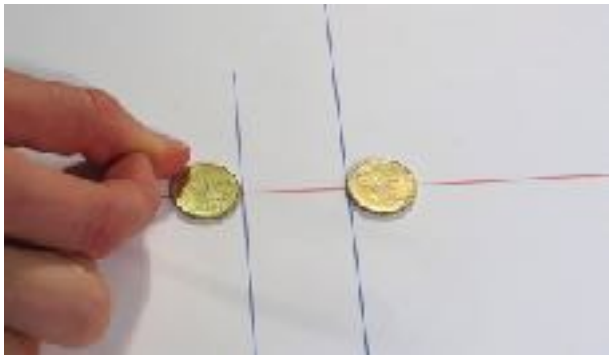

**FIGURE 2.** Flick of the projectile coin. Red line is a guideline and serves to control if the collision of the coins was central or not.


**FIGURE 3.** A 1 cent coin is the projectile and 10 cents, 20 cents and 50 cents coins are targets in this part of experiment.


**FIGURE 4.** More complex variation of experiment.

As said previously all the problems at competition are related to experiments. There were 4 problems referring to collision experiment and one of them is shown in Figure 5. The problem checked if students detected a particular pattern in observed collisions: when a lighter object centrally hits a heavier object, the projectile

reflects backwards. The frequencies of the chosen answers are shown in Table 2 for fourth- and fifth-graders separately. This is no place for detailed analysis of the results, however, from a quick look at the Table 2 we find that fifth-graders performed slightly better than fourth-graders. We also notice easily that the most often chosen answer in both groups of students was not the correct one (A), but answer (B), which would have been the correct one if the masses of projectile and target had been the same. Since all the possible answers were chosen frequently we conclude that distractors were chosen appropriately in this case.

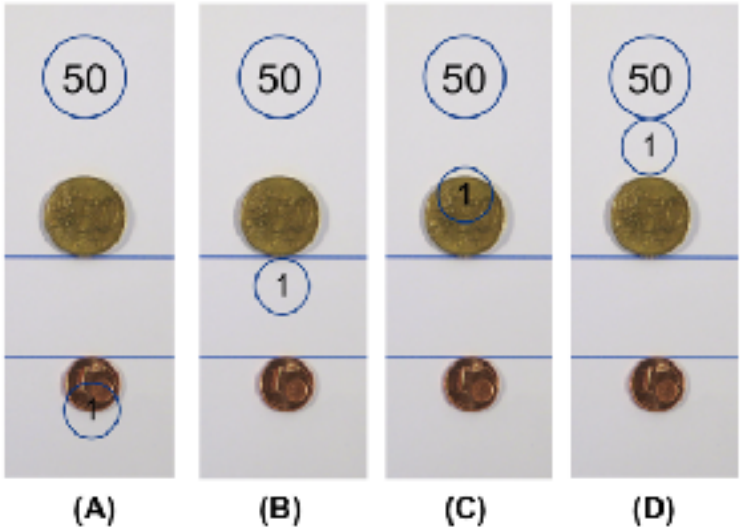


**FIGURE 5.** An example of competition problem related to collision experiment, formulated as follows. *A projectile is a 1 cent coin and it collides with a target, which is a 50 cents coin. Which picture does correctly show positions of both coins **after** the collision?*

**TABLE 2.** Frequencies of chosen answers to the problem shown in Fig. 5 for fourth- and fifth-graders. The correct answer is A and X is for no chosen answer.

| grade | Number of students | **A** | B | C | D | X |
|---|---|---|---|---|---|---|
| 4th | 2126 | **22.77** | 47.84 | 17.64 | 10.07 | 1.69 |
| 5th | 2043 | **26.04** | 47.33 | 19.19 | 6.66 | 0.78 |

## CONCLUSIONS

Introduction of 'just another' competition turned out as a huge success. The most important to our view is the impact of the competition to the school practice. We have learned about several ways that Kresnička was brought into life in different schools. Activities and content from our experiments can fill the regular so-called science activity days, can spice up regular lessons, give reason to introduce an extracurricular activity in the afternoons or help teachers to keep gifted students and those, who are interested in science, busy and keen. We feel responsible to follow the path outlined in the successful first years.

## ACKNOWLEDGMENT

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