

INFN ScienzaPerTutti: an overview of the annual contest for schools

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ScienzaPerTutti, literally ScienceForAll, is the web portal dedicated to Physics education and popularization of science curated by INFN Italian National Institute for Nuclear Physics' researchers. The contents are mainly addressed to High School students and teachers and are designed to engage the audience with the main topics of modern research in particle and nuclear physics, theoretical and astroparticle physics. The missions are to promote public awareness of science, to raise interest towards the importance of discoveries along with the applications in everyday life, to support teaching/learning of modern physics using innovative methods. The portal, created in 2002, has evolved through the years including different multimedia products like didactic units, research materials, columns, infographics, videos, interviews, book reviews, and podcasts, and expanding the reachability that has currently an average of 3000 entries every day. After an introduction to the leading sections of ScienzaPerTutti web site, this contribution will present the development of the annual contest addressed to Middle and High-School students that, in 2023, arrived at its XVIII edition. Every year the contest is devoted to a different topic and participants are asked to design and realize a multimedia product to share their work. In 2023 the contest was centered on the Physics of sports, students have to choose a sport and describe the Physics beyond it. In particular, High School students were also asked to imagine the same sport played on another planet or in condition out of the ordinary to invent a new sport. 299 teams from 95 Italian schools applied for the 2023 competition and we will here report about the works and the outcomes.

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1. Introduction

ScienzaPerTutti is a Physics communication and popular science project based on a website [1] whose contents are curated by researchers of the Italian National Institute for Nuclear Physics (INFN [2]). The INFN research community is committed to this project to make accessible to the public the main issues of science, in particular physics, and technology. The target audience is represented by High School students and teachers moreover the website is visited by people passionate about science as well. The main purposes of the project are to inform people about the research conducted by INFN, to increase awareness toward the latest issues in Physics presenting both the discoveries and the applications in daily life, to provide research materials and didactic units that serve as a support in teaching/learning modern Physics. Created in 2002, the website is in constant evolution to keep the pace with the development of learning media [3]. The last layout renewal was completed at the beginning of 2023. Nowadays the portal is structured in different areas whose contents are in Italian language. In 2022 the portal recorded almost 680000 entries and 1.090.000 pages were visited.

2. Website structure and main sections

The portal is composed by more than 2000 pages that have been recently organized in five sections to allow our visitors easy access to their contents. These sections are named respectively:

- **Didactic paths** containing educational resources about classical and modern Physics;
- **Columns** including scientists' biographies, book reviews, podcasts;
- **Schools** that is a repository of periodic and annual contests;
- **Ask the expert** where visitors can interact with the editorial board, writing science related questions and curiosities;
- **Made in SXT** that gathers posters and multimedia products realized by the ScienzaPerTutti team.



Figure 1: The homepage banner of ScienzaPerTutti website [October, 2023].

The didactic paths include 45 resources and research materials divided into 5 areas: astrophysics, particle physics, nuclear physics, theoretical physics, and history of physics. These educational products provide in-depth content about the key concepts of classical and modern physics and scientific discoveries. They illustrate the main experiments and introduce the scientists who conducted them. These resources serve as tools for teaching/learning physics and have also been used as research materials for the paper that high school students have to produce for their final exam. Each path is organized in a table of contents to facilitate access. The most viewed didactic path from 2021 up to now is *A look at the light* that, as suggested by the title, is dedicated to the characteristics of light, the main phenomena related to geometric optics, with examples and references to everyday life, the spectrum of electromagnetic waves and the connection between light and the theory of Relativity. In the second and third place respectively there are the paths devoted to *Subatomic Particles* and *Special Relativity*.

Another popular section is represented by the column dedicated to scientists' biographies, with the five most viewed ones from 2021 until now being those of Julius Robert Oppenheimer, Lise Meitner, Galileo Galilei, Robert Hooke, and Marie Curie.

This column is an example of how some products designed for online fruition become products that can also be used in public events. Indeed, this column has sparked the idea of creating a calendar, *Calendar 2021, 12 months of discoveries*, where we presented the lives of female and male scientists, protagonists of major achievements in Physics in the XX century. This project was realized in collaboration with the illustrator Francesco Fidani, and the calendar was sent to 500 high schools. Moreover the same project evolved into a science exhibition *Modern Physics through scientists and challenges*[4], based on illustrations and biographies that were organized in an immersive art installation that was presented during the 2021 Rome Science Festival. In 2023 the exhibition was also realized in a portable layout version to be shared with other INFN units around Italy.



Figure 2: The 2021 ScienzaPerTutti Calendar that became a science exhibition.

As part of the activities aimed at engaging the public, we include a monthly contest that is based on multiple-choice questions related to science issues. These questions are published on the project’s Facebook page, the first ones to answer correctly win a ScienzaPerTutti branded gadget. A selection of the monthly questions was turned into a card quiz based science game that is played during festivals and public events to entertain the participants with scientific curiosities. Furthermore, last year the collection was organized into an app named BANG [5].



Figure 3: On the left and example of the monthly contest questions that have evolved into a card quiz game presented during public events and ultimately turned into an app (banner on the right).

3. Annual contest for Schools

Since 2005 every year we organize the traditional competition for schools that consists in a call to action in which, given a particular topic, students have to conduct a research about it and realize a product merging creativity and communication skills. This is a very important activity that allows us to have insights about the perception of students towards physics. Themes and format change every year. In figure 4 it is displayed an overview of the themes treated in the last 10 years.



Figure 4: The collection of banners from the last 10 editions of the annual contest for schools.

In the following sections, we will focus on the format, a selection of works, and the participation turnout of the last three editions. In all these cases there were 3 participant categories: I category – Middle School students, II category – High School students – age 14-15, and III category – High School students – age 16-19.

3.1 2021 edition: Mistakes. The wrong Physics

In this contest, students were asked to find an error related to Physics issues in movies, songs, literature, and arts. The contest combines three rounds in which participants have to: 1) write a short text to introduce the selected subject and to explain the mistake, 2) create a meme to summarize the research, 3) realize a 2-minute video about the mistake and its implications. The participants to this edition were 91 teams with a total number of 356 students. The selected projects we here report are *Banksy and Archimedes' principle* and *Physics and Furious*. In the first project, students start talking about the meaning of artwork *The Balloon girl* by Banksy so they introduce the social and historical context and then they explain why it is not plausible for the girl to be lifted up in the air by 7 balloons, applying Archimedes' principles and making precise calculations. In the end, their message is that they hope the dreams of this girl do not follow Archimedes' principle [6]. The second team analyzed a scene from the movie *Fast and Furious*, and they explained using kinematics why the car protagonist of that sequence is not capable to jump from one building to another at a particular distance [7].

3.2 2022 edition: Eureka! Chronicle of a discovery

The theme chosen for the 2022 edition was scientific discoveries and facts. Students were asked to select a discovery or a fact in the history of science. Playing the role of journalists, they had to create a short video announcing the discovery as if they were living in that particular period. The participant categories were the same of the 2021 edition. A total of 300 students participated in the competition, forming 92 teams. We here want to mention the team who performed the chronicle of the Manhattan Project with a focus on the atomic bomb and the principle of nuclear fission [8], the team who put on an interview to Evangelista Torricelli, where the actor illustrate its invention, the barometer [9].

3.3 2023 edition: The Physics of sport

Being the participant categories unchanged, in the 2023 edition students were asked to pick a sport and explain the Physics behind it, realizing a 5-minute video or audio, or a short text. In addition, high school students aged 16-19 had to envision the same sport being played, for example, on the Moon or underwater, altering the boundary conditions. They were then required to invent a new sport. The project should also include a story for promotion on the ScienzaPerTutti Instagram channel. In this year edition, 1100 students participated with 299 teams. More than 40 different sports were selected by students. We want to mention the team presenting the Physics of table tennis and explored what would happen if the sport were played on a planet with twice our gravity [10], the team that described the law of kinematics applied to volleyball [11], and the team that illustrated the physics involved in the snowshoe hiking [12].

4. Conclusion

INFN ScienzaPerTutti is a web portal dedicated to the main Physics topics and in particular to the research conducted by INFN. The aim is to inform High School students and teachers about discoveries, experiments and key concepts of modern Physics. Feedback is positive, having an average of 2500 entries per day, nevertheless we would like to enlarge our reachability and several updates will be performed in the near future. We are planning focus groups with our target audience in order to optimize some of the contents. As the interest in participating in public outreach initiatives is growing, we are working on exhibits and products related to the content of the website that will be showcased in public events. The annual contest for schools is a meaningful activity that allows us to probe the interest of students towards science and have important feedback. We are currently designing a new format to improve the engagement of students.

5. Acknowledgements

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