



The Inaugural Kenyan Schools Crystallization Contest

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Acronyms and Abbreviations

ADP	Ammonium dihydrogen phosphate
CSIC	<i>Consejo Superior de Investigaciones Científicas</i>
DIPC	Donostia International Physics Center
ECA	European Crystallographic Association
IUCr	International Union of Crystallography
LEC	Laboratorio de Estudios Cristalográficos
NRF	National Research Fund
UoN	University of Nairobi
FST	Faculty of Science and Technology

1. EXECUTIVE SUMMARY

Inspiring the next generation of scientists through education and outreach activities has produced remarkable outcomes in the recent years. In the field of crystallography, crystal growing competitions, which have been running for many years in different countries with the support of the International Union of Crystallography (IUCr), have gained popularity. However, these contests have mainly taken place in Europe and USA.

In Kenya, a team of scientists from Spain and Kenya successfully organised the first crystallisation contest on 25 January 2025 inspired by previous successful editions in Spain. This contest was part of the programme “Learning how science work with crystals”, being the second step of this programme that started with the workshop “Crystallography at the School” held in late November 2023. During this workshop, high school teachers were trained on the fundamentals of crystallography and practical ways of growing crystals. In 2024, students from various schools proceeded to grow crystals under the guidance of their teachers using the innovative crystallization kit of Ammonium dihydrogen phosphate (ADP). The objective of holding this contest was to stimulate interest in science among high school students through enjoyable activities while learning how researchers work. In its inaugural edition, the event featured sixteen teams comprising sixty-six students from five schools. These participants showcased their projects through various formats, including posters, oral presentations, logbooks, and crystals.

The contest was similar in format to a ‘Scientific Conference’ in which groups of students presented their crystallization projects to a panel of scientists who evaluated based on a set of criteria and selected the winners depending on points scored. The oral presentations displayed a high level in communication skills and a good understanding of the basic concepts such as solubility, supersaturation, nucleation and crystal growth. Creativity was observed in all the groups including use of locally available materials such as the African calabash in place of the Styrofoam crystallization kit that had been provided for crystal growth. All the participants were presented with certificates, and the top three winner schools. of the contest were presented with Professional Biological microscopes among other prizes. To encourage further interest in the field and to ensure visibility of this contest, all participating schools received handheld USB microscopes.

This contest was organized by a Spanish team (CSIC/DIPC) headed by Prof Juan Manuel Garcia-Ruiz in collaboration with a Kenyan team (UoN/AESA) headed by Dr Martin Mbugua.

The following report was produced as part of the proposed programme for teaching science through crystals in Kenya.

2. MAIN REPORT

After the successful three-day "Crystallography at the School" course held in November 2023, participating schools received crystallization kits generously donated by the Laboratorio de Estudios Cristalográficos (LEC), IACT, CSIC. These kits, widely utilized for educational purposes, included ammonium dihydrogen phosphate (known for its ease of crystal formation), a plastic container, a Styrofoam container, and detailed instructions. Equipped with the kits, with the teachers already trained during a Training workshop for Kenyan High school Teachers held in November 2023 on "Learning how Science works with crystals" and their students embarked on a crystal growth journey in anticipation of the upcoming contest. To ensure the project's continuity, the team of scientists from the University of Nairobi maintained regular follow-ups with the schools and provided additional support in cases where the originally trained teachers were no longer available. This proactive approach helped sustain the initiative and kept the schools engaged in the project.

2.1. Title of Event

The Inaugural Kenyan Schools Crystallization Contest

website: <https://kenyancrystallizat.wixsite.com/blog>

2.2. Purpose and objectives

The purpose of this contest was to introduce Kenyan students to the fascinating realm of crystallography, science and scientific work, developing transversal skills like critical thinking, teamwork, and learning skills, sparking their curiosity and encouraging the organization of similar events in the future. This initiative seeks to address the existing gap in this scientific field, particularly across the African continent.

The specific objectives of the contest were to:

- Instil practical skills to young scientists in crystal growing.
- Promote STEM vocations in pre-university students
- Introduce students to research procedures.
- Train young scientists in critical thinking and presentation skills.
- Evaluate and provide feedback on the projects.

2.3 Work completed (activities and outputs)

Prior to the contest, all participating teams were given standard guidelines outlining the minimum requirements for participation. These requirements included:

- 1) Creating a poster of standard dimensions to describe their project,
- 2) Submitting a notebook containing detailed experimental information,
- 3) Presenting their crystals for assessment, and
- 4) Preparing an oral presentation to deliver to the judges.

The students were provided with sufficient time to set up their posters and display their crystals in the analytical chemistry laboratory at the University of Nairobi. At the evaluation stage, most of the time was dedicated to understanding the students' crystal-growing journey, including differences in methodology, challenges faced, results achieved, and their overall grasp of the process. Each group was allocated 8-10 minutes to present their work.

An eight-member jury, composed of scientists—Vincent Madadi, Daniel Ichang'i, Patricia Gitari, Fredrick Mwazighe, Ruth Othiambo, Eunice Nyawade, Ruth Omole, and Fermin Otálora—evaluated and scored the projects. Given that this was the inaugural contest, the grading system was simple and straightforward. The evaluation criteria focused on:

Poster: Assessing whether the content followed a logical flow and included all essential information.

Notebooks/Logbooks: Reviewing the documentation of experiments, data collection, and observations.

Oral Presentation: Evaluating the students' understanding of the process and their ability to respond to questions from the jury.

Crystals: Judging the quality of the crystals and the creativity demonstrated in their growth.

Presentation of results by students



The jury carefully evaluated and graded the schools based on the established criteria. However, special considerations were considered when assessing different groups of students from the same school, as they were all guided by the same teacher (s). The work presented by these groups showed similarities, with only minor variations in their overall projects. Judges placed particular emphasis on creativity and troubleshooting techniques, which indicated that the students were prepared to repeat experiments to achieve the perfect crystals.

The oral presentation was given greater weight in the evaluation, as it is a crucial skill in scientific research. The ability to clearly and logically explain complex processes, as well as effectively respond to questions from the judges, provides valuable early training for students aspiring to pursue careers in STEM fields. Notably, Aga Khan High School, who eventually won the first prize enhanced their presentation by recording a video documenting the crystal growth process, adding a dynamic element to their project.

The award ceremony was held at Millenium Hall 1 on the Chiromo Campus. In addition to the judges, the event was attended by several distinguished guests, including Solomon Derese, Associate Professor at FST at the University of Nairobi (UoN); Martin Mbugua, Senior Lecturer at the Faculty of Science and Technology; Juan Manuel Garcia-Ruiz, Professor o at DIPC; Fermin Otálora, Senior Researcher at IACT, Spanish National Research Council in Granada; Ms. Natalia Suarez de Puga Canosa, Consul at the Spanish Embassy to Kenya; Dickson Andala, CEO of the National Research Fund as well as a member of the Inaugural Executive Committee of the African Crystallographic Association, representative from the Kenya Chemical Society; Leonidah Kerubo, Dean of the Faculty of Science and Technology (UoN); and Dr. Santiago García Granda President of the IUCr, who delivered his remarks via video conferencing. Dr. Garcia Granda expressed his enthusiasm for supporting Kenya's first crystallization contest.

The lead judge, Patricia Gitari, outlined the assessment process prior to presentation of awards. This step was crucial in emphasizing that the contest was not solely about producing the best crystal but also about recognizing the importance of the entire experimental process. Participating schools were awarded digital microscopes, while the top three schools—Aga Khan High School, Buru Buru Girls Secondary School, and SCS Swaminarayan Academy—received professional microscopes, among other prizes.

Awards ceremony



2.4. Lessons learned, follow-up, overall conclusions, and recommendations.

Overall, the crystallisation contest has been successful and well received by the students and teachers. This was visible from the displayed enthusiasm and calls for future competitions.

Despite their limited knowledge of crystallography, all the participants showed clear indications of attempts to optimise conditions for crystallisation. They were able to describe the quality crystals based on methodology while relating this to saturation, cooling rate and vessels used. They displayed a good understanding of the concepts such as solubility, supersaturation, nucleation and crystal growth. Hence it was important that their hard work was recognized during evaluation.

While the event was a success, there were a few challenges during the planning stages in 2024. Of note

- Transfer of previously trained teachers. This was mainly in private schools which usually have high attrition rates as compared to public schools
- Late confirmations from public schools due to delayed letters of authorisation from the Ministry of Education. **NB:** Public schools cannot participate in any educational activity without permission from the Authorities.

Way forward in future contests

- Formulate contest rules and regulations to fit local conditions.
- Plan well in advance and consider the school calendar (both private and public) for optimum participation.
- Involve more public schools in the contest as they operate in resource scarce environments. This will bring about equity and inclusivity.
- Request authorisation from the Ministry of Education well in advance (at the start of the experiments).
- Mobilise resources from industry to sponsor awards.
- Aim at involving the Ministry of Education, science educators and more stakeholders for wider visibility.

2. ACKNOWLEDGMENTS

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- Donostia International Physics Center
- University of Nairobi
- International Union of Crystallography
- The Spanish Embassy in Kenya
- Bruker
- Members of the Jury
- The Technical staff of UoN
- Volunteer postgraduate students
- José Antonio Gavira (CSIC)

Annexes

Program



1st Kenyan Crystallization Contest
Chiromo Campus, University of Nairobi
25th January 2025



Program

Facilitators: Solomon Derese and Martin Mbugua

Time	Activity
8:30 – 9:00	Registration
9:00 – 10:00	Setting exhibits
10:00 – 13:00	Exhibition and judging of exhibits
13:00 – 14:00	Lunch
14:00 – 15:00	Speeches Dr. Martin Mbugua, UoN Prof. Naumih Noah, KCS (Nairobi Chapter Chair) Santiago García Granda, IUCr Prof. Juan Manuel Garcia – Ruiz, DIPC Prof. Leonidah Kerubo, Dean, FST, UoN Prof. Andala Dickson, NRF Ms. Natalia Suarez de Puga Canosa, Consul at the Spanish Embassy to Kenya
15:00 – 15:30	Remark by the chair of Jury Prize giving Closing Remark

Group Photo

List of participating schools and teachers

S/No	Name	Organisation
1.	Tata Wekesa	St. Christophers International
2.	Bowman Kasoso Awour	St. Christophers International
3.	Otemba Violet Joyce	Buruburu Girls Sec. School
4.	Francis Murigi	Buruburu Girls Sec. School
5.	Chara George	SCS Swaminarayan Academy
6.	Pascal Kahindo	SCS Swaminarayan Academy
7.	Samwel Otieno	Regis Runda Academy
8.	Dennis Murunda	Regis Runda Academy
9.	Jacinta Mwendu Mutiso	Aga Khan High Sch. Nairobi
10.	Anthony Mwangi Kamau	Aga Khan High Sch. Nairobi

Judges

S/No	Name	Organisation
1.	Dr. Vincent Madadi	University of Nairobi
2.	Prof. Daniel Ichangi	Geologist
3.	Dr. Fredrick M. Wazighe	University of Nairobi
4.	Dr Patricia W. Gitari	A.E.S.A
5.	Dr Ruth Othiambo	University of Nairobi
6.	Dr. Eunice Nyawade	Jomo Kenyatta University of Technology
7.	Dr. Ruth Omole	Technical University of Kenya
8.	Dr. Fermin Otálora Muñoz	Consejo Superior de Investigaciones Científicas

Organisers

S/No	Name	Organisation	Contact
1.	Solomon Derese	University of Nairobi	sderese@uonbi.ac.ke
2.	Martin Mbugua	University of Nairobi	martinmbugua@uonbi.ac.ke
3.	Patricia Gitari	A.E.S.A	pgitari11@gmail.com
4.	Juan Manuel García-Ruiz	Donostia International Physics Center	juanma.garcia Ruiz@dipc.org
5.	Fermín Otálora Muñoz	LEC, IACT, Consejo Superior de Investigaciones Científicas	f.otalora@csic.es



The organisers at the event venue with the Consul at the Spanish Embassy. From left to right, Martin Njogu Mbugua, Natalia Suarez de Puga Canosa, Juan-Manuel Garcia-Ruiz, Patricia Gitari, Fermín Otálora and Solomon Derese.



*Training our future
leaders to understand
how science is done,
technology is created,
and how it is
communicated to society.*