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Conference Report

«Elémentaire !»

The 2019 Science Contest for Schools in Geneva to Celebrate the International Year of the Periodic Table

Didier Perret, Guillaume Laty and Hans Hagemann*

*Correspondence: Prof. H. Hagemann, E-mail: hans-rudolf.hagemann@unige.ch
Chimiscope, Section de Chimie et Biochimie, Université de Genève, 30, quai E. Ansermet, CH1211 Geneva 4

Abstract: In the context of the International Year of the Periodic Table, the chemistry outreach platform Chimiscope of the University of Geneva organized a science contest for all pupils in Geneva from primary school to high school. The objective was to identify the elements in a series of samples using flame emission with increasing sophistication: for primary schools, the children had to associate the observed color with the colors indicated for some elements on a periodic table, for the intermediate degree the elements had to be identified using information available in the literature and on the web, and for the high school a papercraft spectrometer was provided to record the emission spectra with a smartphone. Additionally, each class had to provide an imaginary element, as well as an activity report. Finally, the participants from the intermediate level had also to realize an acrostic poem based on chemical elements. 48 classes participated in this contest.

Keywords: Chemistry outreach initiative · Flame emission spectroscopy · International Year of the Periodic Table · School science

1. Introduction

Since 2014, the *Chimiscope*, the public experimentation and discovery chemistry laboratory which is member of the Scienscope of the University of Geneva,[1] and its partners organize a science-related contest for school classes of Geneva, starting with a contest on crystal growth.[2] 2019 was declared the International Year of the Periodic Table (*https://www.iypt2019.org/*). To participate in this celebration, the Chimiscope designed a contest for schools at all age levels based on flame emission.[3] The basic concept was to provide a set of eight different salts which produce different emission colors when introduced into a flame, and the objective for the classes was then to identify the elements of the different samples, retracing thus also an historical aspect of element identification in the 19th century.

2. Initial General Rules of the Contest

All classes had to create an imaginary element and present it on a single A4 page.

For the elementary schools, the objective was to observe the flame emission of the different salts provided and to associate the emission color with a specific element based on a periodic table in which some boxes were appropriately colored. A report describing the activity in the class together with the annotated table to identify the elements provided had to be returned.

For the intermediate level, the elements had to be identified based on information extracted from literature search, including the use of internet, and the report had to include the sources of information, which were used. Further, the class had to compose an acrostic, *i.e.* a small poem in which each line starts with the symbol of a chemical element and in which the initial letters of the lines form a word or phrase when read vertically.

For high school, each class received additionally a papercraft spectrometer[4] to record with a smartphone the emission spectra of the flames, which were then used to identify the unknown elements.

3. Safety Considerations and Other New Constraints

Working with open flames is obviously a safety issue. Before launching the contest, we tested several simple flame sources available in every household and found that instead of a laboratory Bunsen burner it is also possible and much safer to use a conventional alcohol fondue stove or a small torch for crème brûlée to observe a nice colored flame (see Fig. 1).

Fig. 1. Typical red flame of a strontium salt observed with a torch for crème brûlée; the tip of the moistened wooden stick carrying the salt is visible near the mouth of the flame.

To minimize any risk of burning, about 20 cm long wooden sticks were recommended, the procedure consisting in moistening the tip, inserting it into the powder vial and then subjecting it to the flame to observe the emission color. This procedure is in our opinion much safer than to provide Bengal matches reaching higher temperatures, which are sold in Switzerland without restriction to anybody older than 12 years, not to mention the fact that Bengal matches contain emitting elements which would mask or modify the color of the flame produced by the unknown elements provided in the contest kit. For all the chemicals provided to the classes ($CaCl_2$, $Cu(NO_3)_2$, $CuSO_4 \cdot 5H_2O$, Cs_2CO_3, KCl, Li_2SO_4, NaCl, $SrCl_2 \cdot 6H_2O$), safety data sheets from Swiss retailers were put on the contest website, as well as a short video showing the best way to perform the contest under high safety conditions. In the week after launching our contest, the Geneva Education Department issued a general order for the primary schools to forbid the use of open flames in the classroom, while for secondary schools all experiments had to be performed in fume hoods with appropriate safety equipment (gloves and goggles); in addition, a ninth salt (H_3BO_3) had to be removed from all kits for health safety reasons, although boron salts are readily sold over the counter in pharmacies. To allow nevertheless the participation of primary school classes, we then recorded small videos of the flames and made them available to the participants.[5] A few primary school classes were able to come to the Chimiscope and to perform the experiment there. Due to

Fig. 2. Atoms in the ground state (left) and in the excited state (right) as seen by 4- and 5-year-old children.

this unexpected development, only seven primary school classes took part in our contest this year, considering that last year, 55 classes from primary schools participated in our contest. This is particularly unfortunate, as the Geneva Education Department organized this year a special science awareness program for the 7th class of the primary schools, and this contest could have made a good addition to this program.

4. Results

The combination of scientific experiment and artistic creation of this contest made it difficult for the jury to evaluate the results. Some classes had amazing artistic ideas for the imaginary element or the acrostic poem, with a more average scientific approach, while others focused much more on the identification of the elements and neglected the artistic aspect. All the works returned for the contest can be found on the website of the Chimiscope.[6]

Primary Schools (Harmos 1–8)

The first prize went to the class of C. Suchet and E. Ciurlia, Ecole Primaire Charles-Giron (class 1P, *i.e.* 4–5 years old). As you can see in Fig. 2, explaining ground and excited states of atoms are no secret to small children.

The second prize was awarded to the class 7P of L. Silva-Alexandre (Ecole primaire de Livron), and the third prize to the class 6P of A. Duparc ((Ecole primaire de Belle-Cour).

Intermediate Level (Harmos 9–11)

The first prize was awarded to the class 1131LS (Cycle d'Orientation de Montbrillant; see Fig. 3) of R. Lepera, D. Baiao Oliveira, R. Teasdale and L. Di Martino, and two second prizes were awarded to the class 1111CT (Cycle d'Orientation de Drize) of N. Nahum and to the class 1131LSb (Cycle d'Orientation du Marais) of J. Marti, J.-Y. Genoud and J.-G. Cruz. It is important to note here that to improve chances for the contest, several chemistry teachers teamed with colleagues from other disciplines (French, visual arts) to realize the contributions of their classes.

Fig. 3. Imaginary element and acrostic poem of the winning class.

High School

The first prize went to the class 2CH-OS-09 of M. Caillet-Dayer (Ecole de Culture Générale Henry-Dunant; see Fig. 4), the second prize to the class Year-12 of L. Aquilante (British school of Geneva) and the third prize to the class 3CH-05 of C. Helgen (Ecole de Culture Générale Henry-Dunant).

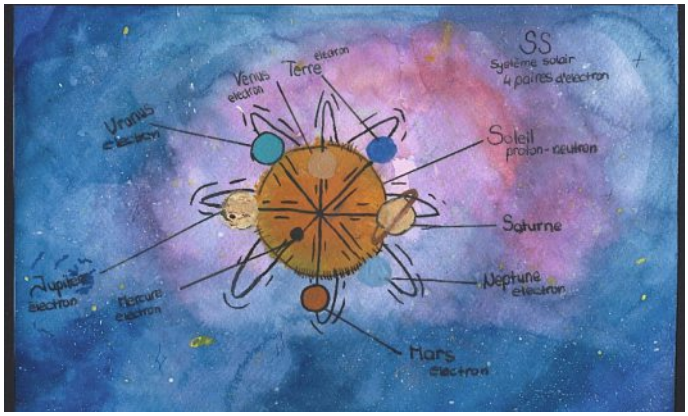

Fig. 4. Imaginary element of the winning class (category high school).

It is worth to note here that, following the example of the illustration above, many classes of all levels created imaginary elements, which were modelized according to the physicist's point of view or to the Bohr's model of the atoms, *i.e.* with electrons gravitating aroung the nucleus like planets around their star. This points out that chemists still have a lot of work to do in order to popularize amongst the young audiences the concept of electron orbitals.

5. Award Ceremony

On May 15, the award ceremony took place in the Sciences II building of the University of Geneva. The president of the jury was Fiami who is renowned for his comic books retracing the history of the scientists Einstein, Galileo, Marie Curie, and Newton.[7] After a short presentation related to the contribution of Dmitri Mendeleev, the winners were presented. Each award-

winning class received a trophy with a periodic table and a prize for each pupil of the class, and the ceremony ended with an informal get-together. The organizers of this contest are very grateful to all participants to have contributed with enthusiasm and creativity to this international year of the periodic table.

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[1] *https://scienscope.unige.ch*, the public science platform of the University of Geneva.
[2] D. Perret, H. Hagemann, R. Cerny, C. Renner, E. Giannini, L. Guénée, C. Besnard, D. Gérard and L. Windels, *Chimia* **2014**, *68*, 893.
[3] *https://scienscope.unige.ch/chimiscope/2019/03/13/elementaire-grand-concours/*, link to the description of the contest.
[4] *https://publiclab.org/wiki/papercraft-spectrometer*, link to the provider of the DIY spectrometer.
[5] *https://youtu.be/cWUPLD6F5rA*, link to the video showing the colors of the flames, for primary school pupils.
[6] *https://scienscope.unige.ch/chimiscope/photos/concours-2019/*, link to all results of the contest.
[7] *http://www.fiami.ch*