THE MOTIVATING ROLE OF THE FULL DAY EXPERIMENT PROGRAMME CALLED "PHYSICS SHOW" IN TEACHING PHYSICS AND CHEMISTRY

József Jaloveczki
Szent László Education Centre, Baja, Hungary, jalo@freemail.hu

ABSTRACT

Our school organized an experiment show day for the eighth time in 2015 where students demonstrated and explained experiments in physics and chemistry (in the last two years in biology, too) to their fellow students. In this article I will provide a short review of the history and organization of the full-day experiment programmes held for the public annually. I am going to report the way how the composition of the visitors, their number, and their opinion have developed during each programme. My accompanying students demonstrate a few physics and chemistry experiments chosen from the former show programmes, which can motivate learning physics and chemistry.

INTRODUCTION

In this article I am going to introduce our "Physics show". The show is a round-the-clock presentation of physics experiments. It takes place in our school, in Szent László ÁMK, in the city of Baja, usually in late April. The first show was held by students from the study group of physics in 2001. The renewed shows have continued since 2007 with attached chemistry and later biology experiments. The shows are organized year by year by study group and science workshop students with the help of their teachers.

THE PREPARATION FOR THE "SHOW"

After selecting the experiments, we choose the members of the groups for presentation. They practise in study groups, in science workshops, in the afternoons and sometimes in class if the experiment fits in the curriculum. We advertise the show in schools in town and in nearby villages, in newspaper ads, in the local radio and TV and on the Internet. Fig.1. shows the number of students carrying out experiments

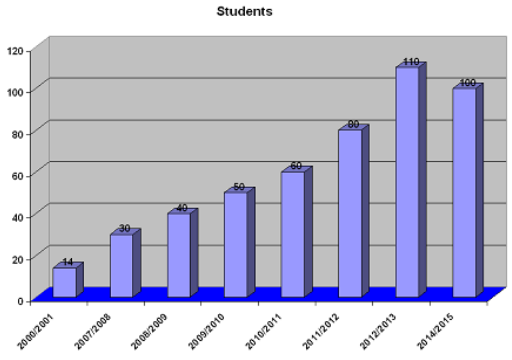

Fig.1. The very first show was held by only the study group students in 2001. Since 2007 volunteers also have been able to take part along with the study group students

VISITORS

The visitors of the show consist of our students, students from the schools in the area, their teachers, and children from the nursery school. We have very positive feedback. They expect to have it every year and encourage us to organize it again. Fig.2. shows the estimated numbers of the visitors of our show.

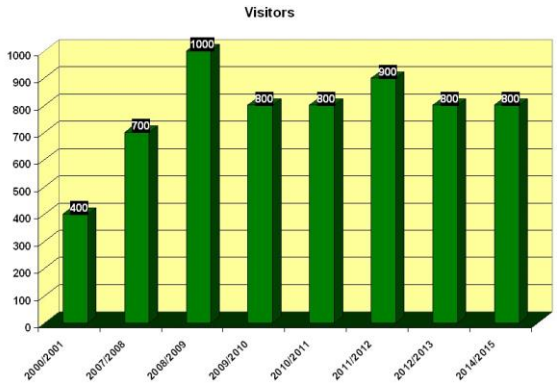

Fig.2. The estimated number of visitors based on preliminary registrations. In 2008 the show was held in two mornings

EXPERIMENTS

We selected experiments from books and from the internet. We have already demonstrated mechanics, electricity and magnetic phenomena, light and heat phenomena, nuclear physics together with chemical and biological phenomena. Fig.3. shows the increasing number of experiments in the shows. In 2001 on the anniversary of the discovery of the nucleus we carried out exactly 100 experiments [1].

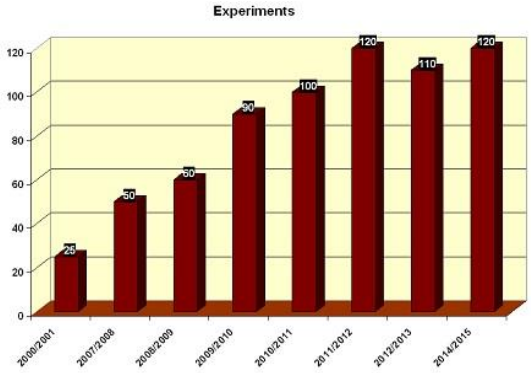

Fig.3. The increasing number of the physics show experiments

THE FIRST EXPERIMENT: ELEPHANT TOOTHPASTE

In this experiment, 30% or 35% hydrogen peroxide is mixed with some liquid soap, and then a catalyst is added (potassium iodide), to make the peroxide break down rapidly. As the peroxide breaks down, it releases a lot of oxygen. It results in a very showy outpouring of tiny soap bubbles. Hydrogen peroxide contains a lot of oxygen. The more concentrated the peroxide is, the more oxygen it releases. The oxygen gushing out is what makes the soap bubbles move. As the peroxide breaks down the soap that was mixed in will also combine with the water and turn into foam. A burning match reveals the presence the oxygen. Often some food colouring is added before the catalyst, which makes the resulting column of foam gushing out look even more like toothpaste. Fig.4. shows a student dropping a match into the foam [2, p.638].

Fig.4. A burning match began to glow dazzlingly because of the oxygen.

THE SECOND EXPERIMENT IS: HYDROGEN GUN

Our hydrogen gun is made from a plastic film box attached to a plastic tube. We filled the film box with air mixed with hydrogen. Hydrogen gas is produced by reacting an active metal, zinc (Zn), with hydrochloric acid (HCl). Having fixed the top, the compound is blown up with a sparkle made by a piezo-lighter. This exothermic reaction yields 286 kJ/mol of water formed. The rapid release of a considerable amount of energy causes the surrounding air to expand suddenly, resulting in a sharp explosion. The best 'pop' is usually achieved with a mixture containing 20 - 40 % by volume of hydrogen. Fig.5. shows the ignition of the mixture by a piezo-lighter [2, p.461.].

Fig.5. By pushing the piezo lighter Dóri starts the combustion of hydrogen-air mixture

THE THIRD EXPERIMENT: A LAMP FROM PENCIL REFILL

A thin pencil refill is placed between alligator clips fixed to a stand. It is connected to the power supply and the current is slowly increased. The thin graphite starts glowing due to the Joule-heat and then the carbon goes into reaction with the oxygen. At this time the pencil refill begins to glow dazzlingly. We cover it with a glass shade. The light goes out when the graphite burns away and cracks. Fig.6. shows the glowing refill when current flows through it [3].

Fig.6. The pencil refill starts glowing dazzlingly because of the Joule heat. The reaction between the carbon and the oxygen increases temperature

THE FOURTH EXPERIMENT: CONDUCTIVITY OF GLASS

Bulbs are set up in serial connection, one of them is broken and the tungsten filament is removed. This light bulb is heated in the closed circuit. When all the glass has melted permanently the other lights starts glowing again. Glass is in fact is a high viscosity liquid. During heating its viscosity decreases and it is able to flow (ductile over 600 ^{o}C). Cations can always be found in glass (Na^{+}, Ca^{2+}, $Mg^{2+)}$ as well as anions (HCO_3^{-}, BO_3^{3-}), which are able to move due to the electric field resulting from an electric current. If it cools down, it will stop. Fig.7. shows heating the glass of the broken bulb and the other one beginning to glow [4].

Fig.7. Tünde heats the glass of the broken bulb to melt it

THE LAST EXPERIMENT: BURNING MONEY

Prepare a water-alcohol mixture by combining rubbing alcohol with of water. Make sure to stir the mixture thoroughly. We used 50 ml of 95% ethyl alcohol with 50 ml of water. Borrow a bank-note from your friend. Dip it into the mixture of water and rubbing alcohol making sure it is completely soaked. Remove it using the tongs - squeeze out any excess liquid. Hold one end of it with tongs and light the bottom of it. The bank-note will *seem to be* burning, but it should not burn (famous last words). When the flame is completely extinguished, it is safe

to touch the money... you will find that the money is even cool to the touch. Alcohol burns with an almost invisible blue flame. One trick is to add a little table salt to the water-alcohol mixture to make the flame more visible. The water from the water-alcohol mixture absorbs much of the heat energy that is generated when you light the bank-note. If you reduce the amount of water in the mixture, the paper money is likely to be charred or even catch fire. Fig.8. indicates the girls burning my 5000 HUF [5].

Fig.8. My "bad" students are burning my bank-note, fortunately they are not able to

POSITIVE OUTCOMES

In our school only a few students want to take a final exam in physics. As a consequence, they show little interest towards the theoretical and calculation problems of the subject. These events arouse the students' interest towards the phenomena and the experiments. During work they appear to be patient and try to be precise.

They are open to recognise interesting experiments found on the Internet. If necessary, they gear the given experiment to our facilities, to our appliances at hand. Their self-confidence grows when the experiment compiled and revised by themselves works. Even if it does not work, their endurance and creativity improve while correcting. Their communication also improves. They are proud to show and explain the experiment to the visitors, especially to their fellow students and teachers and do it in a very concentrated way.

They get better at experimenting and at manual skills. They become more patient, they get to the core more easily, sometimes even their aesthetic skills improve during the preparations and the presentation. They get more involved, certain rules and concepts get meaningful for them. Their skills in dealing with problems improve especially in solving practical difficulties. Their efficiency in learning academic curriculum gets better after they have relived the joy of understanding and carrying out an experiment. They enjoy showing and explaining experiments to visitors, their attitude towards the subject improves. Most of the visitors are students from our school who take in the explanations coming from their fellow students better than the usual teachers' ones.

On the whole, the episodes of the physics "show" mean twice as much for the presenting and the visitor students as even a double-time longer physics lesson. During the consecutive weeks several of them would like to take part in the presentation, in the work of the study group and ask about the date of the next show.

ACKNOWLEDGMENTS

I am thankful for the assistance to my little students, Dóra Janotka and Tünde Hegyi. We thank for the help of our school's management and the upholders for their grant of money.

REFERENCES

1. J. Jaloveczki: "Fizikashow", a fizika népszerűsítésének eszköze, Fizikai Szemle **11**, 388, 2012. (in Hungarian)
2. William L. Masterton, Cecile N. Hurley: *Chemistry Principles & Reactions*, Saunders College Publishing, Orlando, 1989.
3. https://www.youtube.com/watch?v=DOrebc3hocA
4. https://www.youtube.com/watch?v=HBnICnUhTZI
5. http://www.stevespanglerscience.com/lab/experiments/burning-oney#sthash.JMvf4wac.dpuf