Fun Physics in School: Students Perform for Students

The auditorium of the Amos Comenius Gymnasium in Bonn is packed with 400 students. It is completely darkened: Lena creates methane filled soap bubbles, and her partner Stefanie ignites the rising bubbles with a gas flame. The result is a spectacular burning gas cloud which lightens up the whole stage and the faces of the beaming audience. It is the final of 18 exciting experiments which 16 high school students (aged 15 to 18) have presented as a 75 min physics show to their fellow students.

This project was initiated by Werner Urff, physics teacher at the high school, and Herbi Dreiner, a physics professor at the University of Bonn. For the past six years, Herbi Dreiner and second year physics students have been presenting a new Physikshow every year at the university. It's a two-hour show where the students demonstrate and explain funny, fascinating physics experiments to an audience of mainly young middle school students and whoever finds his way into the completely filled auditorium. The experiments are partly taken out of the physics department's collection, partly invented and built by the students themselves. Also less spectacular experiments are entertaining, when combined with music to help get the message across: physics is fun. Fun is also what the students are in for, since there is no grading or other curricular advantage for them. They enjoy physics and prove it to their audiences in each performance.

After visiting a show, Werner Urff and his students thought: "Wouldn't it be great for us to present a show in our school?!" Herbi Dreiner and eight university students, all Physikshow veterans, supported them in the preparation. Two months prior to the show the experiments were chosen by the high school students out of our large demonstration pool. Of special interest were experiments which the school does not have, because they are too expensive or too large to store. The school students formed groups of two and chose experiments they would present and explain in the show. Each group was supervised by a university student. The groups first met in our lab and tried their experiments before the actual school rehearsals.

On each of the following four afternoons the students and two Physikshow members met in the school's auditorium and rehearsed for four hours. It took one afternoon to build up and arrange all the experiments, another two to rehearse the experiments, work on comprehensible explanations and find out the best camera angles for the big screen projection. The latter was done by the school's student stage crew which takes care of lighting, sound, etc. for school plays. The fourth afternoon, finally, saw two runs of the whole show with shorter interruptions by the Physikshow "coaches" to help smooth transitions between various experiments and resolve details such as how to hand over the microphones from one experiment to another.

Although this was not enough rehearsal time, the final result was amazing. The students performed a great show with tremendous confidence and - most importantly - they had loads of fun. Lena and Stefanie probably embody this process the best. At the beginning, they seemed not very motivated or interested. Significantly, they asked whether they might get a better grade in their physics class for participating. However, during the rehearsals, they emerged as group leaders and displayed a great will for perfection in performing their experiments. After the show their mindsets had completely changed: "We are so glad that we took part. It is so much fun. Let's do it again!"

Interestingly, half of the group were girls, none of them highly interested in school

physics before. But the show became an opportunity for them to be creative in physics and thus get more involved.

If you want to initiate a project like this, your primary motivation should be getting the message across that physics is extremely enjoyable and entertaining, both for the performing students and for the audience. Though the show demanded a lot of time, work and resources, it was definitely worth it. The high school students did not only learn some physics, they learned to organize themselves as a team and to perform confidently something they care about in front of 400 people. They fully identified with their show, and only needed a nudge, to get going.

Only few high schools can work together with a closeby university on such a project. But half the fun is actually finding and building experiments yourself. This requires a longer preparation time, but is also much more rewarding. There are endless ideas for experiments on the internet and in books. Or just play around for example sticking things in a microwave (under supervision) to see what is fun. Three of our most successful experiments were very cheap. The methane soap bubbles. A 25kg steel ball pendulum hung from the ceiling. We had a teacher on stage and released the pendulum just in front of her nose. The camera was focused on her frightened face as the ball returned. Furthermore, we had a large plywood box, 1.4m in each direction, with a 40cm circular opening on one side and a plastic foil covering the opposite side. We filled the box with stage smoke and banged the back foil. This released a large stable smoke ring which traveled accross the entire auditorium. With a spot light in a dark hall this was a spectacular effect. Music is also very helpful. Good experiments are often more a question of presentation, than money. Anyway, parents and school board can possibly provide modest financial assistance for materials: such events can attract external visitors and media to a school.

Our success getting students involved is confirmed in another project at the Gesamtschule Hennef, near Bonn. Six years ago Ingo Wentz, a physics teacher, started the Physikusse, a student group (www.physikusse.de). They meet weekly and work on different physics projects. Once a year they participate in the competition "Freestyle Physics" at the University of Duisburg, where students have to meet challenges like building their own hovercraft. They have also planned and performed several physics shows by simple means, starting with 20 min performances on school open days. Wentz himself talks of "low cost physics". When they need e.g. liquid nitrogen for one of their experiments, it is provided upon request by local companies. They receive modest financial support from the school board and Wentz gets a slight reduction in his teaching load.

In summary, students performing physics for fellow students is a great way to get kids of all ages motivated and attracted to physics. It is rewarding for the audience, the teacher and most of all for the participating students.

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More on the Bonn University Physikshow:

http://cerncourier.com/cws/article/cern/31198

Inspiration for experiments:

http://physikshow.uni-bonn.de/index.php?job=Versuche

Book on show experiments: "Physics Demonstrations: A Sourcebook for Teachers of Physics", by Clint Sprott, Univ. of Wisconsin Press