

House of Science – a university laboratory for schools

K. Erik Johansson

House of Science and Department of Physics, Stockholm University,
AlbaNova University Centre, SE-106 91 Stockholm, Sweden

2004 Physics Education 39 (4) 342

House of Science in Stockholm is a university science laboratory for physics, astronomy and biotechnology, entirely devoted to schools. The laboratory makes modern science accessible to teachers, school classes and individual students. It could serve as a model for universities and science centres that want to bridge the gap between school and higher education, to make natural sciences at school more interesting, or to introduce students to experimental sciences in regions where it is uncommon at school.

Background

During the last few years there has been a worrying decrease in interest at school for natural science, particularly physics and chemistry. As natural science plays an important role in high tech corporations and society in general, a lot of the technological progress of our society depends on the future science students. In response to this problem, there have been several initiatives in Sweden to make natural science more interesting and to show how university studies can result in interesting jobs. Natural science in general and physics in particular, are often regarded as difficult subjects at school. These fields of science are in rapid development and many teachers find it difficult to keep up with the challenges that this involves. This is where House of Science [1] at AlbaNova University Centre and part of Royal Institute of Technology and Stockholm University, has an important role to play.

The concept

The aims of House of Science are to stimulate interest in natural science and technology, strengthen contacts between schools and the university and demonstrate links between science and the “job market”. It is important that students can see that university studies lead to interesting jobs.

In House of Science we work closely with school science teachers and put at their disposal a well-equipped laboratory for interesting and sometimes rather advanced experiments. Many of the experiments are normally not accessible at their schools.

The laboratories are staffed by young scientists, undergraduate university students or research students working on their doctorates from Stockholm University and Royal Institute of Technology. Visiting students appreciate the informal contact with these university students and young scientists, and this makes university look less distant. Senior scientists also contribute to the activities at special occasions by giving more specialised talks and presentations.

Partners

The House of Science is embedded in the university world, with tight links to the local school community and high-tech enterprises. Partners include Stockholm University and Royal Institute of Technology, the local community, the City of Stockholm, the company AstraZeneca and several foundations. The City of Stockholm is a particularly important partner and their teachers and students have free access to House of Science. These partners joined forces and built on the success of earlier projects like Science Laboratory [2] and the youth programme.

As House of Science is neither a school nor a university, its status is unfamiliar to the financing authorities. These authorities tend to think that House of Science is an excellent idea, but someone else should pay for it. This has been, and still is, a complication.

Teacher activities

The teachers are one of the most important target groups. There are three types of activities for teachers:

- Individual tours through the laboratories
- Workshops for groups of teachers
- Plenary science seminars and presentations

Many of the teachers' first contact with House of Science is via newsletters, internet or colleagues. Very often this first contact is followed by a personal visit, after which they decide to bring their class. When they visit the laboratory with their classes, teachers actively participate, generally assisting the young scientists in charge, but sometimes leading the activities.

The workshops for teachers usually focus on a particular theme, such as exploring the interior of matter, dark matter in the universe or working with new analysis and experimental techniques.

Larger teacher meetings, typically for 50-150 participants, take place both at the House of Science and the AlbaNova University Centre. These meetings start with one or two talks by senior scientists and deal with recent findings at the frontiers of science. These meetings finish with demonstrations and experimentation in the House of Science.

Enquiries and discussions with teachers show that one of the main reasons for visiting House of Science is the interesting experimental programme that fits well into the school science curriculum, and at the same time is more advanced than what can be done at their schools. Their other main reason is the contact with the university and the research environment.

Student activities

The House of Science is primarily devoted to students aged 12-19. Most students visit the laboratories as a member of a school class. A visit lasts between two and six hours.

Students also visit the laboratories without their teacher. Summer research classes go on for two weeks outside the school term. The participants, typically age 17, are students particularly interested in science. To date, subjects have been the exploration of the interior of matter using the Hands on CERN education program [3, 4] with data from real particle collisions from the DELPHI experiment [5], and the exploration of the Milky Way using a radio telescope [8].

During the last year at school each student does a 100 hour individual project. An increasing number of students are doing part of that project work in the House of Science. Project topics have included the fundamental constants of physics, physics in medicine, genes and transmutations, and dark matter in the universe. Visiting students make good contact with undergraduate and research students only a few years older than themselves and learn what it means to study and do research at university. This seems to be particularly appreciated by those who are close to finishing school.

Together with our partners we inform visiting students and teachers about possible job and career possibilities.

Courses for the young

Summer courses for 14 and 15 year old girls attract more than 200 participants. They experience many hands-on experiments, dealing with physics, chemistry and technology that can be observed everywhere around us, like the behaviour of air, water, sound, light and electricity. Several laboratories at the House of Science, AlbaNova and the Royal Institute of Technology are used for these large groups of girls. Similar courses take place for 10 or 11 year olds on weekends during the school term. Altogether more than 300 youngsters take part in these courses that last for a total of 7-9 days.

The laboratories

The House of Science itself has four laboratories and occasionally uses some of the laboratories in AlbaNova University Centre as well as other laboratories at Stockholm University and Royal Institute of Technology. The experiments that take place in these laboratories vary from simple and amusing to rather complex and problem-oriented experiments.

The biotechnology laboratory is equipped with four phase contrast microscopes, enabling students to view bacteria and cells, and four 3-D microscopes suitable for objects like banana flies. The laboratory is also equipped with a pyrosequencer in order to determine DNA sequences. At present the biotechnology laboratory can receive up to 12 students at a time.

The physics laboratories each have eight laboratory “islands” for four students, equipped with power supplies, computers and space for more special laboratory equipment. Each laboratory is connected to an open workshop with a mixture of exhibitions and equipment that visitors can use on their own.

The astronomy laboratory is equipped with binoculars, a small stellar telescope and facilities to use Hands on Universe [7], and School-Astro [8]. For stellar and planet observations the cupola of AlbaNova is used. A larger stationary stellar telescope in AlbaNova and a solar telescope in House of Science are planned.

A small auditorium for up to 40 people is used to receive the classes and to say farewell to them after reviewing the laboratory session. The auditorium is equipped with a projector producing wide screen images connected to a video, a DVD, a computer connected to the web and a good sound system that is also used for special sound experiments. The auditorium is an important complement to the laboratories.

Evaluation

In 2003 there were 14 000 visits by students and teachers, almost double the number who visited in 2002. A total of around 600 school classes or groups of students and teachers visited the laboratories. The table below shows the number of primary, secondary and high school groups.

<i>Age group</i>	<i>Nr of group visits</i>	<i>Total nr of visitors</i>
Primary, secondary school (12-15)	210	4 300
High school (16-18)	330	5 000

The House of Science, sometimes complemented with the AlbaNova and other laboratories, were also visited by around 100 groups of 6-8 children for typically 7 days adding up to a total of more than 4 000 visits. In addition a few “research” classes with students from many of the schools in the region spend two weeks of their summer holiday making more advanced experiments. This is a group of very interested and talented students.

Evaluation forms show that what students aged 12-15 most appreciate is the experiments. Around 85% say that what they remember most about their visit was the interesting experiments and being able to study living organisms. The older students, aged 16-18, most remember interesting experiments (50%) and new experiences and concepts that they were confronted with (30%). [Results based on 150 replies.]

Conclusions

Stockholm House of Science is very popular with teachers and students of all ages. Many of the laboratories are fully booked far in advance. After just two years of operation we are operating close to full capacity.

The House of Science could serve as a model for universities and science centres elsewhere that want to bridge the gap between school and higher education, to make natural sciences at school more interesting, or to introduce students to experimental sciences in places where it is uncommon at school level.

Acknowledgements

The House of Science would not have been possible without the work of Torsten Alm (primary school laboratory), Lena Gumaelius (biotechnology laboratory), Christer Johansson (courses for girls and young children), Christer Nilsson (high school laboratory), Magnus Näslund (astronomy) and Elisabet Olgart (primary school laboratory and information material).

The House of Science could be realised thanks to the Knut and Alice Wallenberg Foundation, the City of Stockholm, AstraZeneca, Royal Institute of Technology, Stockholm University, the Foundation for Strategic research, the Science City Foundation and its director Kjell Jegefors.

References

1. House of Science homepage: www.houseofscience.se or www.vetenskapenshus.se
2. Stockholm Science Laboratory for Schools, K.E. Johansson and Ch. Nilsson, Physics Education 34/6(1999) 345
3. Hands on CERN home page: <http://hands-on-cern.physto.se>
4. Hands on CERN - a Particle Physics Education Project utilising the Internet, K.E. Johansson and T.M. Malmgren, Physics Education 34/5(1999)286-293
5. DELPHI home page: <http://www.cern.ch/Delphi/Welcome.html>
6. Astronomy and particle physics research classes for secondary school students, K.E. Johansson, Ch. Nilsson, J. Engstedt and Aa. Sandqvist, American Journal of Physics, Vol. 69, No. 5, May 2001, p. 577
7. Hands on Universe homepage: handsonuniverse.org (a Swedish link: hands-on-universe.physto.se)
8. School-Astro see www.houseofscience.se or http://www.astro.su.se/skolastro/omskolastro_eng.html

Photos, illustrations

1. The House of Science
2. Girls playing with a solar system model in the primary school laboratory.
3. a. Checking the Mercurius passage outside House of Science in summer 2003.
b. Mercurius in front of the sun.
4. Two students analysing a DNA sequence.