

# Nine Years of Scientific Research Training in Hungary

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## 1. Introduction

Between 14 and 21 years is the age of self-discovery, when the adolescent explores his or her capabilities and limits and seeks a place in society. In short, puberty is a challenging time for many parents and teachers when their children and students question their "wisdom", and set out to find answers to problems that they think their parents cannot properly address. Science and research offer a unique opportunity for adolescents to quench their thirst for answers and explore their intellectual strengths and capabilities. Research in a laboratory and interaction with other scientists provide a new social environment for these students, where they can earn recognition of their capabilities and find role models that they might not encounter at school, at home or with their friends. Moreover many students who carry out research in a laboratory are often also able to find their first real friends in this new environment.

Attracting young students to scientific research has also become a topic of growing importance from science's point of view because the numbers of students who choose a career in the natural sciences is decreasing. Many senior scientists, economists and politicians in the USA and Western Europe concern about a potential bottleneck of scientists and engineers, which could hamper the growth of high-tech industries, particularly biotechnology and information technology. These problems –how to give young people a basic knowledge of science and technology and potentially awaken their interest in a research career– are clearly recognized and have become a subject of many conferences.

These are some of the reasons why an unprecedented initiative has been presented by Peter Csermely, Professor of biochemistry at the Semmelweis University (Budapest, Hungary), which resulted the foundation of the Hungarian Research Students Movement in 1995.

## 2. The Mentorship Program

The main goal of the Movement is to help talented and motivated students in the ages between 14 and 21 (free of charge) in order to obtain first-hand experience of scientific research in Hungarian universities or research institutes. The idea immediately gained an overwhelmingly positive response from the Hungarian scientific community. We were able to start the programme in 1996, with approximately 300 scientists willing to act as mentors and accept high-school students in their laboratories.

The cooperation between talented students and the professors is helped by a book containing the list of our mentors who accept high school students in their laboratories. We are proud to say that nowadays there are more than 700 researchers who support our initiative. Many of these senior scientists are of the highest scientific merit: 118 are members of the Hungarian Academy of Sciences, including Nobel Laureate George Olah. The list of mentors is originally published as a book and it is delivered to each member also via e-mail containing a wide range of keywords (approximately 3000 from abortion to x-ray micro-analysis) to help the students decide what their field of interest really is. Every high school head teacher gets it in Hungary and in the surrounding countries as well, because we have several hundred ethnic Hungarian students from neighboring countries (Slovakia, Ukraine,

Romania, Serbia, Croatia and Slovenia). Since the beginning, we have been able to offer more than 7,000 students—not only from Hungary, but also from other Eastern European countries—a chance to work in a real research laboratory. It has been a great success so far, as many of these students become interested in pursuing a career in scientific research or teaching. But, equally important, we have also gained a great deal of experience of how to get young people, who are still open to outside influences and new challenges, interested in science.

To recruit new students, the list of mentors is sent to each Hungarian high school and to more than 600 high-school teachers who help us with the recruiting. Any interested student can apply in writing or via our website<sup>1</sup> by answering two simple questions: “*Why do you want to pursue research?*” and “*Why do you feel that you are better than other students?*” The aim of these questions is to test the students’ motivation, self-esteem and maturity. The registered students get our list of mentors and here comes the next screen: after having made up his or her mind, the student has to approach the mentor of choice alone. Parents - dreaming of their children as future Nobel laureates - are purposefully excluded from the recruitment process. If students feel disinterested or experience any trouble, they can contact the coordinator, and he helps them to solve their problems, or find another lab. We also have no strict age limit. The youngest student we have enrolled so far was 11 years old however, most of the students are between 17 and 19. Very importantly, 50% of registered high school students have always been girls which shows an equal interest for scientific research in both genders. More than half (59%) of recruited students work in life science laboratories, while 27% and 16% pursue their research in other natural sciences and social sciences/humanities, respectively. These ratios, which have been fairly stable over the last four years, show the popularity of the life sciences among the young generation, especially the fields of environmental and medical research.

Among the Hungarian students, a quarter have come from Budapest, 29% from Hungarian towns with a population of more than 100,000, another quarter from smaller towns and 21% from villages. We are particularly glad about this

last fraction, because our initiative gives them a unique chance to change their life and break out of the closed and often depressing environment of these less developed regions. We have also had many student researchers from Roma families and from state orphanages, who are probably the real successes of our initiative. “You completely changed my life!” is a remark we often hear from participants. “I met a new world here. I learned perseverance and endurance during my years of research. The friendly atmosphere helped me to overcome my shyness, and the wide variety of topics in the mentor database made me realize what am I really interested in life and pursue it with full devotion,” explained one of our 17-year-old student, emphasizing the effect it has had on her life. Indeed, many of the first high-school research students are now about to finish their PhDs, or have returned to their schools as teachers and are now helping to recruit the next generation of student researchers.

There are no rules or expectations about what a research student should achieve. Some end up with only limited experience, by reading and discussing a book or scientific papers with the mentor. However, most of the students find a stimulating environment, even with their first research team. Clearly, not every interested student could easily get their own research project, as mentors have the right to test them how prepared they are. There are labs where the students have to pass oral or written exams of material the professors give them. After a year, the research results are often mature enough to be presented in a student conference. Many times the students’ work evolves even further –some high school research topics have developed into undergraduate or even Ph.D. projects. It has been a great success so far, as many of these students become interested in pursuing a career in scientific research or teaching. Some of them have returned to their schools as teachers and now help to recruit the next generation of student researchers becoming mentors.

In 1998, a Research Student Foundation was established to manage finances, and the annual budget of the Foundation grew to approximately €60,000 by 2004. Twenty-five per cent of these funds come from the Hungarian Ministry of Education, another 25% from foreign institutions, including UNESCO (the United Nations Educational, Scientific and Cultural

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<sup>1</sup> [www.kutdiak.hu](http://www.kutdiak.hu)

Organization), FEBS (the Federation of European Biochemical Societies), 30% is received from grant applications and 20% is donated by Hungarian firms. In 1999, students, mentors, high-school teachers and scientific research clubs also formed a Hungarian Research Student Association (Csermely et al., 2000). All decisions, including those about finances, are made by the student president, at present Katalin Sulyok, and their two deputy presidents, who are elected each year by the best 80 student researchers during a one-week research camp.

After the Research Student Foundation announced in 1999 that it would help to establish science clubs in high schools (Csermely et al., 2000), more than 200 such clubs have been founded in Croatia, Hungary, Romania, Slovakia and Serbia. Members of these clubs cooperate in larger research projects and inform each other regularly of their progress. Most of the research clubs invite established scientists to speak about their lives in research, or to talk about recent advances in their field.

A student if once a scientific project is carried out has the opportunity every year to present the results at seven regional conferences held in Hungary, Transylvania and Serbia, the best third of the student lecturers get a chance to present their results at the national conference where the most prominent persons of Hungarian science make the jury evaluating the presentations and performances in different sessions: human and natural sciences are both to be found. The best students of the National Conference - approximately 80 each year - are invited to a one-week summer camp in July near Lake Balaton. The best Hungarian scientists are invited here to talk about their approach and devotion to science just like a few respected writers, clerics and successful business- or statesmen with whom the opportunity of discussion is open for the participants. University undergraduate psychologists help these outstanding student researchers to cope with their loneliness and other personal problems; grant agencies present their funding programs, teaching students how to apply for funding, and the Hungarian Patent Office demonstrates the importance of protecting intellectual property. Another essential event takes place here every year the President and the two Vice-President of the Hungarian Research Student Association gets elected. The winners of the National Conference

can take part in other international science-camps, and the best Hungarian high-school research student is invited to the Nobel award ceremonies each year in Stockholm, Sweden. The selection of the student is made by a special interview of the best ten students, organized jointly with the Hungarian Association for Innovation. It is our goal to extend international contacts in the future, and to improve the regional co-operation in Central and Eastern Europe.

We also established a network of 600 high school teachers to recruit research students to the initiative and/or establish science clubs in their own school. Starting in 1999, we have organized annual conferences for these teachers to exchange information on fundraising, and how to establish science clubs organize local conferences and recognize talented students. The conferences also include discussions with government officials on governmental help to enhance research activities in high schools, and to increase the number of Ph.D. studies among high school teachers. In 2005 these high-school teachers agreed to establish the Hungarian Research Teacher Association in order to give an official framework of their cooperation.

Why is this movement successful? Because it approaches the future scientists in their most susceptible age. Science is an open-ended endeavor. The tremendous challenge of discovery brings a great power of motivation for teenagers. Being in science - they become free. They can discover their talent - and the limits of this talent, too. Our movement is creative, flexible and playful - like research itself. This movement is based on volunteer work; there is no benefit for getting involved but the joy of help, but the joy of science. This movement is self-organizing: it is led by the high school students themselves. They learn not only research, but research ethics, science communication, co-operation, management-, and leadership roles. These are all much-needed values in our disorganized, segregated societies. Moreover, half of the students come from small towns and villages. This movement gives an unparalleled opportunity to break social barriers. At home - these research students are deviants, a kind of high school E.T.-s. Here - they discover friendship and find a new home. Science becomes their home. And this bond is strong. Our first students got their PhD and became

mentors, or went back to their schools as teachers and started to organize research teams. But those may be the best treasures, who will not pursue science. Wherever they go, be it business, politics or raising their children: they will remember – science *was* their home. The long-range links these research students build in their most susceptible age have an unparalleled value. These links promote public understanding, help to stabilize our societies and keep our best talents to return to Europe - wherever they go. We are happy that this idea has been recognized by the EU: the movement received the Descartes Award of Scientific Communication in 2004.

### 3. The Network of Youth Excellence

All around the world there is an increasing number of initiatives that ensure research possibilities for motivated secondary school students. These initiatives, however, work in isolation and in many places they work almost completely out of public knowledge. This is why it is deemed important that UNESCO and other sponsors ensured a possibility for the exchange of experiences among the best initiatives worldwide within the framework of the Network of Youth Excellence. More than 30 countries all over the world already consider to join to this network. The Network of Youth Excellence has only organizations as its full members, all regional, national and international organizations are eligible, which have an experience of at least two years in extracurricular education of young students - ages below 21 - in science and technology. The Network is completely independent, and works closely with the UNESCO World Academy of Young Scientists to establish contacts with other young scientists working as university undergraduates, Ph.D. students or postdoctoral fellows world-wide. The backbone of the Network are two mailing lists - one for full members and another for interested organizations and individuals – and the new website.<sup>2</sup>

Full Members of the Network agreed on a Memorandum of Understanding which sets out the main objectives of the Network of Youth Excellence:

- promote cooperation between existing scientific research training projects for students until the age 21 and their teachers

in a wide array of scientific areas;

- promote research collaborations between students and teachers of different programs and countries;
- facilitate the collaboration with international organizations of young scientists such as the World Academy of Young Scientists (WAYS);
- better the existing projects by exchanging their experiences and outlining successful organizational and fundraising tactics;
- help the initiation of scientific research training projects in countries where they currently do not exist;
- initiate international joint scientific student/teacher projects;
- promote the participation of students in the organization of research training programs;
- encourage an inter- and multidisciplinary dialog on the ethical and responsible conduct of research and use of scientific knowledge as well as on social aspects of scientific research;
- draw the attention of policy makers and the media to the importance to start the recruitment to scientific research at a very early age.

The Network treasures the diversity:

- of the approaches for science education and research training in target group (talented, underprivileged, motivated students; science teachers; society around the students and teachers, etc.),
- content (subject- or scientific discipline-based projects; participation in top science; broad, interdisciplinary projects; fun-type projects, etc.),
- methods (courses, summer schools, weekend seminars, continuous projects, lab-type projects, school-type projects, cyber-courses, distance-learning, etc.)
- aims (information transfer, ability development, raising self-confidence, raising long-lasting interest and commitment to science, help in science communication, help in applied research, promotion of public understanding, etc.).

The formal establishment of the Network is a currently ongoing process, so far more than 15 organizations have joined the Network as Full Members, and there are 12 organizations who applied for Organizational Partnership. The

<sup>2</sup> [www.nyex.info](http://www.nyex.info)

Network is governed by the Board - each Full Member has a representative - while the everyday decisions are made by the Executive Board comprising the Chairperson, the two Vice-Chairperson, and one representative of the Secretariat. To be cost effective the Network does not have an own administration body, the role of Secretariat is performed by one of the Full Members for a four years period of time.

#### 4. Conclusions

After nine years, we have gained a lot of experience about how to attract young people to science and research. The first and most important fact that we learned is that students must be offered the possibility of doing real science, not didactic, over-organized pseudo-research or experiments with a guaranteed outcome. Students clearly appreciate the world of research with all its frustrations, uncertainties and technical troubles—and with all the joy that comes with a real discovery. As mentioned above, students between 14 and 21 are eager to try things themselves and explore their limits, so we can present them with new challenges and tasks. Schools might overload them—or rather mis-load them— but science performed in a proper environment never overwhelms their abilities. Consequently, it is also important not to set standards: even the smallest bit of knowledge and understanding that a student gains in a laboratory is worth it. Adolescents at this age need emotional support and personal guidance, so the scientists who serve as their mentors must therefore be willing to get involved and actually spend quite a bit of time with them. It is also important that mentors have a high level of credibility—not only as scientists, but also as role models. A hierarchy-free, democratic research environment, where the only credit goes to real achievement, is a must. Students are also eager competitors, which gives them great strength and motivation to continue, even after repeated failure. But we must not over-use their competitiveness.

We do not want success-thirsty gladiators in the laboratory, we want to educate our future research colleagues. Last, but not least, students also gain a lot of personal experience that has nothing to do with science or research. They still

seek their place in society and explore their strengths and capabilities. Just by giving them a chance to spend some time in a new environment and by positively reinforcing their strengths - and showing them their limits - we can help them to gain a clearer vision of what they can expect from the future. For the vast majority of students, such an experience will create a long-lasting commitment to science and research. However, high-school students who choose a different career are not failures, and the energy we put into them is not a waste. They will keep their commitment to science, wherever they go. And if they return home with the experience of how scientific research works, they often become key opinion makers in their home environment, that is, within their age groups, their families and their local societies. As our commitment to younger students can significantly improve the credibility of scientific research in society in general, we have to mobilize all efforts to show them the joys of science. The best students deserve the best treatment. They are our future.

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