

# Life Science Zurich Learning Center – A New Symbiosis of Research Institutions and Schools

Daniel C. Kiper\*, Isabel Klusman, Claudia Kunfermann, Ladan Sarraf-Zadeh, Alex Butschi, and Lorenz Leumann

**Abstract:** The Life Science Learning Center (LSLC) was officially founded in 2005. It is a branch of the pre-existing Life Science Zurich, an organization created by and belonging to the University of Zurich and the Swiss Federal Institute of Technology Zurich to promote and support life sciences in several central parts of society. The LSLC's primary goals are to offer educational opportunities for school children as well as continuing education for teachers of the primary and secondary school levels. In particular, the LSLC facilitates various types of interactions between schools and the higher educational and research institutions (University of Zurich and Federal Institutes of Technology): it offers practicals for pupils in a special laboratory, tours of professional research laboratories, pedagogical training for future biology teachers, and specialized modules of continuing education for teachers. It also contributes to diverse initiatives promoting life sciences in the general public. It is led by a small team of dedicated people based on the Irchel Campus of the University of Zurich.

**Keywords:** Biology · Education · Life sciences · Pedagogy · Schools

## Introduction

Few scientific domains have seen as many fundamental discoveries as those made in biology during the last decades. Advances in molecular biology, genetics, neurobiology and in evolution theory have had a tremendous impact on our society and are likely to play an increasingly important role in the near future. The Life Science Learning Center (LSLC) plays a very important role in these developments. On one hand, school children of the future will be better informed at an early age about progress in biology. They will understand how important advancements in biological research are for the preservation of our environment and the role biology plays in many societal and ethical decisions. A good understanding of the science behind questions about genetic engineering or ecology, among others, is crucial to make informed,

important decisions in our society. On the other hand, they will also be fascinated by the interdisciplinarity of modern biology, by the extreme sophistication of modern research methods, and by the insights biology provides into human nature and its place in our universe. The LSLC encourages students and teachers to appreciate the beauty of life and biological research. It starts by fostering the fascination of young children for this wonderful and important science and to show them the increasingly tight connections between biology and other natural sciences. It continues by giving teenagers opportunities to experiment and get in contact with researchers. And it ends by supporting the work of current and future Biology teachers who represent the most valuable means to fascinate our children.

## The Life Science Zurich Learning Center: School Labs and Teacher Training

The LSLC was officially founded in 2005 under the roof of Life Science Zurich (LSZ), an organization created to promote life sciences in our modern society. It is therefore a joint project of the University of Zurich and the ETH Zurich and is financed by both institutions. The LSLC is situated at the University of Zurich Irchel Campus, consists of a laboratory room with working space for up to 40 participants, and office space. It is a teaching and meeting point at the interface of research,

the public and education. Another aim of the LSLC is to demonstrate the diversity of the life sciences to the non-academic world. The LSLC not only offers school classes the possibility to better understand the natural sciences, but it is also involved in the education of future biology school teachers and provides a variety of further educational opportunities.

## School Labs

There is a great demand for authentic research experiences in school classes. For example, in 2011 the LSLC was visited by a total of 161 classes ranging from primary school to gymnasium (something similar to high school or A-levels) from all over Switzerland and even nearby Austria. Typically, classes spend half a day or a full day doing practical work in a research atmosphere in the middle of the university campus. For advanced high school students, who had already covered the basics of *Molecular Biology*, it could be most appropriate to sign up for a course focusing on genetic fingerprinting and to solve a criminal case that took place in their own school! (See the case example below). Another option would be to genetically modify bacteria themselves (topic *Gene technology*) – an experiment impossible to perform in a regular high school without special permits. If the pupils had covered *Genetics* at school, some classical breeding experiments with white eyed *drosophila* and other mutant flies might be most ap-

\*Correspondence: PD Dr. D. C. Kiper  
Life Science Zurich  
Life Science Learning Center  
c/o University of Zurich  
Winterthurerstrasse 190  
CH-8057 Zurich  
Tel.: +41 44 635 31 29  
E-mail: danielch.kiper@lifescience.uzh.ch



A school pupils discovers the wonders of the microscopic world at the LSLC.

appropriate to get a feel for how research is done in real labs. Finally, they could also opt to meet tiny, transparent worms (*C. elegans*) that are extremely important model organisms for the study of various diseases including cancer.

Primary school classes are often exposed to modern lab equipment for the first time. They are already very enthusiastic when allowed to look at *drosophila* flies under the microscope or use some simple test tubes, knives and chemicals to extract DNA from vegetables.

The fact that our courses are run by PhD students from research labs turned out to be a win-win situation. The students are highly motivated, gain teaching experience and earn pocket money. On the other hand, the pupils appreciate the authentic spirit conveyed by young people engaged in actual research in biological sciences. The most memorable moments for the pupils are often not directly related to the content

of the lab course, but the little funny stories they tell about their own work. Some pupils even got most interested and excited in scientific research when they simply saw the work space of a PhD student during the lab visit: the mess of paperwork, coffee cups, test tubes, computers and – last but not least – a large couch!

### Teacher Training

Another feature unique to the LSLC is the use of the very same lab/lecture room for teacher training. Once a week, future biology teachers attend lectures of scientists from the Zurich University and the ETH on key topics in biology with a focus on education. They also participate in seminars and present their semester work in a colloquium. This is part of the mandatory regular teacher training and ideally places the LSLC at the interface between higher research institutions and the educational system. In addition, the LSLC organizes each year various events of professional development for experienced biology teachers. Thanks to the team of the LSLC and its well balanced experience in research and education, most of the events have been very satisfying for the participants in terms of both scientific content and practical relevance for teaching.

### Numbers and Target Groups

Since its foundation, the number of events and school visits organized by the LSLC has continually increased. Per year, the LSLC organizes or contributes to about 250 events, in which several thousand people participate (approx. 3,000 in 2011). The LSLC runs roughly 60 lectures and seminars for future Biology teachers and 10–15 modules for current teachers per year. About 150 practicals are performed with visiting school classes and an additional 20 for other groups such as the

'University for children', or the general public. Almost half of the practicals are attended by gymnasium classes, the rest by other secondary school classes and special interest groups.

Our main target groups are:

- Teachers of secondary school level (gymnasias and public schools) (teachers at other school levels can also participate on demand)
- School classes of the primary and secondary school levels
- School children independently from their school class (*i.e.* special programs for gifted students)
- Interested members of the general public
- Special interest groups (*i.e.* medical staff, politicians, journalists)

### Communication

Our courses are described on our web page ([www.lifescience-learningcenter.ch](http://www.lifescience-learningcenter.ch)), where school classes can also register for the various courses. Other sources of information for teachers include our newsletter and special flyers on public events and symposia.

### A Case for CSI Zurich-I: Kidnapping of Rare Fish at Remabill High School<sup>[1]</sup>

The following text was just published in the news section of the Remabill High School webpage

#### **Weird Incident at Remabill High School**

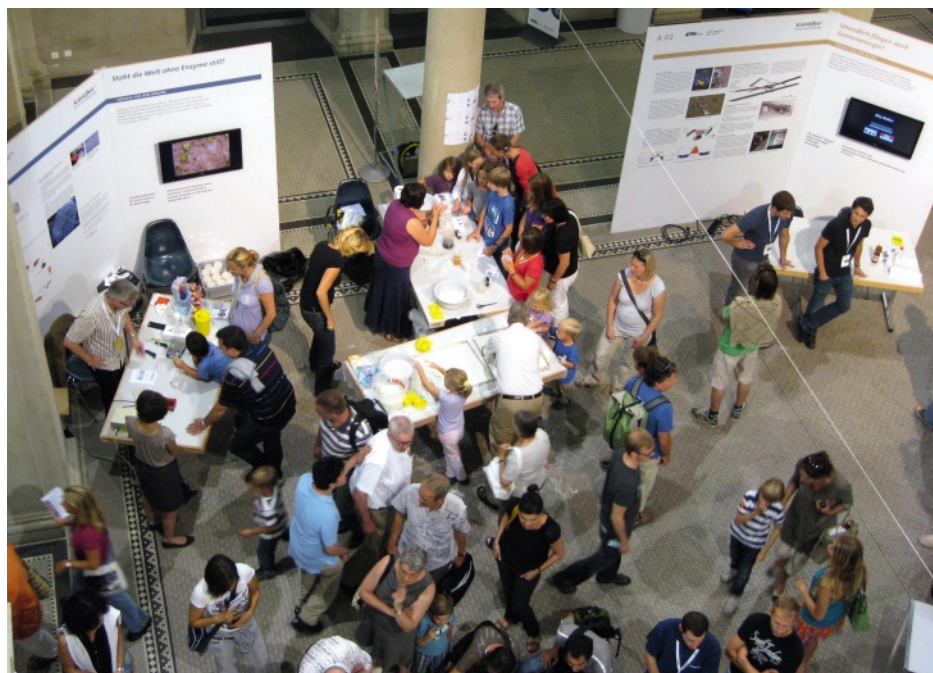
*Science Teachers at the Remabill High School are outraged: Over the winter break a fish tank containing a highly endangered fish species disappeared from one of the classrooms. "The fact that the thief was not afraid to use violence during the criminal*



A school class experiments and discusses results with Lorenz Leumann (on the right) during a LSLC practical.



School teachers experiment during a continuing education course focused on green gene technology.



The general public discovers scientific results and interacts with scientists at the LSLC stand during 'Scientifica – Was die Welt antreibt', August 2011.

act is particularly worrisome”, says S. B., one of the shocked teachers. In fact, two people were harmed during the fatal attack, which culminated in a kidnapping of the fish. Since the stolen fish belonged to a highly endangered species, the case has attracted the attention of several environment organizations; the Endangered Fish Alliance for example has vehemently condemned this criminal act and hopes that the thief will soon be convicted. In order to accelerate the process, specialists of CSI Zurich-I (Crime Scene Investigation Zurich Irchel) have been commissioned to conduct the investigations. Perhaps surprisingly, several Remabill pupils are among the suspects.

### Why Use Genetic Fingerprinting?

Student courses involving theoretical and practical basics of the polymerase chain reaction (PCR) have become popular during the last years. On the one hand, most high school students have the necessary biological knowledge to understand the basic principles of a PCR, on the other hand, this subject is particularly well suited for the incorporation into a context that is attractive to young people. Since its implementation in 2006, the PCR course 'Genetic Fingerprinting' offered by the LSLC has been continuously improved – the fact that the course slots are fully booked during most of the year speaks for itself.

### The Story Matters

The attractiveness of this course is partially due to the direct involvement of the students in the criminal case. Teachers are asked to send photographs of students

and of a fictitious crime scene in advance (without the students knowledge) – these pictures are then incorporated (by the course leader) into a crime story that serves as context and will be solved during the course day. The above case of a kidnapped fish is an example of such a story, which is always pure invention of the course leader or the class teachers (most of whom have become very creative over the years!). The course starts with a power point slide displaying the layout of the school web page, which is of course very familiar to the students. The news section on the page has been manipulated and now shows a short description of the crime and a picture of the crime scene. Ideally, the location shown in the picture is also familiar to the students. In addition, two links can be found on the page: One leads to a short introduction of the organization CSI Zurich-I, which is followed by a more precise description of the crime scene and of DNA evidence that has been found by the CSI team (here, additional pictures sent by the teacher are incorporated into the presentation). Based on this evidence and on statements of school colleagues and teachers (again purely fictional), four suspects were identified. Photographs of these suspects – of course all are members of the class sitting in the course room – have been published on the school webpage and are depicted when clicking on the second link in the news section. Surely by now, the attention of the class has been piqued and the students are very curious about how the case is going to be solved. Not infrequently, students approach their teacher and want to know if the story is fake!

### Alternating Theory and Hands-on Experience Helps Concentration

After an overview slide and a brief introduction of terms used during the course day, the students learn how to use a micropipette in a first practical exercise. Before the actual PCR is set up, another block of theory deals with the process of DNA replication, which is the basic principle behind the reaction. This section usually serves as a refreshment of existing knowledge, since most students have already explored the topic. Using the just introduced micropipettes and led by a protocol, the pupils subsequently mix the reagents needed for the reaction in an Eppendorf tube – water, free nucleotides, primers, DNA polymerase and DNA samples (in this one-day course, we use prepared DNA samples consisting of plasmids with inserts of different size; using primers to the left and to the right of the insertion site, these fragments are amplified during the PCR, which results in a distinguishable pattern on an agarose gel). After starting the PCR machine – the reaction takes 2.5 h – and a break, we answer the question, which usually has already come up during the morning: Which part of the DNA is amplified? Previous experience has shown that this theory block is the most demanding: The description of Short Tandem Repeats (STRs) as a form of genetic variation and how population statistic databases can be used to define the power of discrimination of an individual STR pattern. In order to highlight the relevance of STRs, an FBI webpage showing loci and data sheets of currently used STRs is shown (<http://www.cstl.nist.gov/strbase/fbicore.htm>). Just before the lunch break, the students have another hands-on experience when they learn about the technique used for the later analysis of the PCR – gel electrophoresis – and try to fill the slots of an agarose gel with the micropipette.

### Lab Tour and Blaming the Kidnapper Keeps up the Spirit to the End

After a theoretically demanding morning, the afternoon is dominated by practical work: right after lunch, the PCR samples are loaded on agarose gels and gel electrophoresis is started. During the gel run, another highlight of the course day takes place: A lab tour in a molecular biology laboratory. During a visit at the Institute of Molecular Life Sciences, for example, the students (and the teacher) have the possibility to observe model organisms such as *Caenorhabditis elegans* or *Drosophila melanogaster* – if they are lucky even transgenic animals expressing fluorescent proteins such as GFP – and to discuss questions about current research projects with people working in the lab. But most importantly, the students get a feeling of what it

means to work in a research laboratory – an experience that can be decisive for future careers.

The course day ends with the visualization of the results, which is done by dyeing the agarose gels with a blue stain (in contrast to the laboratory-used ethidium bromide, this stain is non-toxic). When the bands become visible and one of the suspect patterns is identified as being identical to the crime scene pattern, the students are quickly back in the crime story and vociferously blame the convicted offender.

Link to course:

<http://www.lifescience-learningcenter.ch/praktika-labtours/schulklassen/molekularbiologie-2.html>

### Portraits of the LSLC Team

The LSLC as a unique outreach program of the Biology Departments of both Zurich University and ETH Zurich has a very special composition of collaborators with different skills and personalities working as a team.

In the next paragraphs, they give insight into their background, role and motivation for their jobs.

#### **Dr. Lorenz Leumann: Link to High School**

Lorenz Leumann holds a PhD in Biology and a Master of Secondary and Higher Education. He has been working 50% for the LSLC from its beginning six years ago. His main job is to coordinate all activities addressed particularly to high school students and teachers. He is responsible for didactic and pedagogical aspects of the LSLC's program and to make sure that they match the level of the school classes. He also teaches at a high school (Literargymnasium Rämibühl). This is a great combination because of the direct link to high school students and teachers. Lorenz loves working for the LSLC because of the excellent teamwork and the access to facilities and knowhow of professional research. In the field of biology both the Zurich of University and the ETH Zurich are very strong.

#### **Claudia Kunfermann: Link to Primary school**

After a Master's degree in biology, Claudia Kunfermann completed her teaching certification and added a Masters of Advanced Studies in Human Nutrition (ETHZ). During her stay at the University of Zurich, she had her first experience in teaching (mentoring students), which inspired her so much that she then worked eight years as a school teacher. Later she became involved in environmental management as well as teaching special activities for gifted and talented students at levels from primary school up to adult education courses at the technical college level. She has now worked at the LSLC for three years. Claudia's main focus is on the development and implementation of elementary school classes, workshops and public events. In addition, she has a part-time job at the School administration office of the City of Zurich, where, in cooperation with the universities, she promotes science and technology at the elementary school level. Claudia has found her dream job: she enjoys working in a great team, and finds the work in the field of research, teaching and public relations creative and stimulating.

#### **Dr. Daniel Kiper: Link to Universities**

Daniel Kiper originally studied psychology at the University of Geneva with a focus on developmental psychology and pedagogics. He then trained as a neurobiologist at the Center for Neural Science of New York University. He performed research on the neurophysiological foundation of vision in several institutions, in which he also taught many courses on systems neuroscience and neurobiology. Since August 2012, enriched by his experience as a neurobiology researcher, Daniel Kiper decided to return to his long lasting interest in didactics and pedagogical activities and took the position of director of the Life Science Learning Center.

#### **Dr. Ladan Sarraf-Zadeh: School Ambassador**

During her PhD Ladan Sarraf-Zadeh used to work for the LSLC as a regular instructor. Typically about 5–10 PhD

students from different research labs run courses to earn some extra money. This has been a very successful model. According to their feedback, high school students love the little stories about the daily lab life of a PhD student. At the end of her PhD thesis Ladan intensified her contribution to the LSLC and now works half of the time as a school ambassador and the other half as a hardcore researcher. The school ambassador job includes the development of new courses, which are meant to convey the latest scientific findings to the students. Ladan loves to simplify complex biological processes in a way that everybody can understand them. "This makes the work at the LSLC perfect for me."

### Concluding Remarks

The LSLC will continue to expand its offers to school children, students, teachers and the general public and to adapt its program to current developments in biological research. Particular attention will be given to the program offered to children of the primary school level and their teachers. With the development of itinerant teaching modules that will travel to interested primary schools, a wider range of practicals adapted to young children, and continuing education modules for primary teachers, the LSLC aims to wake and promote long lasting interest for life sciences in young children.

The LSLC also aims to expand its offers to a larger geographical area, progressively spreading out to all German speaking parts of Switzerland and neighboring countries. It also aims to further develop contacts between the primary and secondary schools not only with universities and ETH, but also with the technical universities focused on biological research.

The LSLC will thus contribute to give life sciences the recognition and accessibility they need to have in a modern society, to attract bright and motivated students to biological research, and to open the doors of research institutions to the general public.

Received: August 23, 2012

[1] The name of the school has been changed.