From Cutting-Edge Engineering to Social Science Studies Leading to Collaboration with a Governor’s Office of Economic Development

Doing Research in Switzerland

Experiences of U.S. and Canadian Researchers
Contents

Forewords 3
Switzerland at a Glance 4
Switzerland’s Higher Education Landscape 5
Higher Education and Research in Switzerland 6
Scholarships 7
ThinkSwiss 7
Fulbright-Swiss Government Excellence Scholarship 7
Experiences of Young Researchers 8
Neural Engineering 9
Art History 10
Botany 11
Urban and Regional Planning 12
History 13
Ecology 14
Medicine 15
Biology 16
Design 17
Computational Chemistry 18
Social Sciences 19
Forewords

**Ambassador’s Foreword**

“The experiences of young researchers show the range of possibilities that international collaboration opens up.”

Switzerland repeatedly receives high rankings as an innovative and competitive country in comparisons such as the Global Competitiveness Report and the Global Innovation Index. This excellence is driven by the interaction between the public and private sectors and it is driven by international cooperation.

When it comes to research and innovation, Switzerland has a very special relationship with the United States. In international collaborations, Swiss researchers work most closely with scientists from U.S. institutions.

In the next few pages, you will discover Switzerland as a research destination through the eyes of young scholars from the U.S. and Canada who did research in Switzerland. Their stories range from innovations in neural engineering over cultural discoveries in the alleys of Bern to social science studies leading to collaboration with a Governor’s Office of Economic Development in Nevada. They give an impression of the diversity and creativity of Switzerland’s research landscape.

At the Embassy of Switzerland, we promote exchange among young researchers and we are always open to presenting our educational system and providing information about our research landscape.

Martin Dahinden
Ambassador of Switzerland
to the United States of America

**State Secretary’s Foreword**

“International collaborations help to strengthen mutual understanding and advance scientific discoveries.”

Swiss universities are highly competitive: Around 70% of all university students in Switzerland study at a university that is ranked among the top 200 in the most cited rankings. And as a knowledge-based economy, Switzerland offers excellent research facilities.

New scientific impulses are often the result of international collaboration. Through our scholarship programs, we have had close ties with the United States and Canada for decades. The ThinkSwiss scholarship program has provided young researchers from the United States and Canada with the opportunity to conduct research in Switzerland since 2007. Through the Fulbright-Swiss Government Excellence Scholarship program, we have supported U.S. researchers since 1961. When reading about the experiences of past recipients, we see how productive these exchanges have been and how much they can contribute to a person’s career as well as to innovation in a scientific field as a whole.

I am proud to see this flourishing cooperation that helps to foster the mutual understanding between the United States, Switzerland, and Canada which moves science and innovation forward.

Mauro Dell’Ambrogio
State Secretary, Swiss State Secretariat for Education, Research and Innovation
Switzerland at a Glance

**Culturally Diverse**
Located in the heart of Europe, Switzerland is a culturally diverse country with four national languages: German, French, Italian, and Romansch. Switzerland has 26 cantons (comparable to U.S. states or Canadian provinces). Swiss cantons are relatively autonomous, which also contributes to their cultural diversity. Most cantons are German-speaking; the second most common language is French. Additionally, English is widely spoken in Switzerland, especially in business, research, and education environments.

**Knowledge-Based**
Switzerland has a knowledge-based economy. Its strong educational system and favorable conditions for the private sector drive scientific advances and innovation. As in the U.S., public expenditure makes up about one third of all research and development investment. Over two-thirds of all research in Switzerland is funded by the private sector. For its small size, Switzerland has a remarkable scientific output:

- In relation to its population, Switzerland publishes the most scientific papers worldwide.
- Scientific papers from Switzerland have the 3rd highest citation numbers worldwide.
- Switzerland's scientific impact is particularly high in the fields of Physics, Chemistry, Earth Sciences, Agriculture, Biology, and Environmental Sciences.

**Well Connected**
Switzerland is well connected in the global research landscape and a member of many international research institutions and organizations including the European Space Agency (ESA) and the European Organization for Nuclear Research (CERN), which are located in France and Switzerland, respectively. Switzerland has close ties to the European Union that allow Swiss scientists to fully participate in European research programs such as Horizon 2020. Swiss higher education has a strong international appeal; around a quarter of all students in Switzerland are foreign nationals.
Switzerland’s Higher Education Landscape

Location and Size of Universities

- University of Basel
- University of Zurich
- University of St. Gallen
- University of Lausanne
- University of Bern
- University of Lucerne
- Swiss Federal Institute of Technology Zurich (ETH Zurich)
- Swiss Federal Institute of Technology Lausanne (EPFL)
- University of Fribourg
- University of Geneva

Location and Size of Universities of Applied Sciences (UAS)

- University of Applied Sciences and Arts Northwestern Switzerland (FHNW)
- HES-SO - University of Applied Sciences and Arts Western Switzerland
- University of Applied Sciences and Arts Zurich
- University of Applied Sciences and Arts Eastern Switzerland (FHO)
- Bern University of Applied Sciences (BFH)
- Lucerne University of Applied Sciences and Arts
- Kalaidos University of Applied Sciences and Arts
- University of Applied Sciences and Arts of Southern Switzerland (SUPSI)

No. of students

- Swiss nationals: 101,460
- Foreign nationals: 16,676
- Swiss students abroad: 6,868
- Total number of students: 124,904

Swiss universities: 101,460
Foreign universities: 16,676
Swiss students abroad: 6,868
Total number of students: 124,904

Students of other institutions (not shown): 13,165

Students of other institutions (not shown): 13,165

© State Secretariat for Education, Research and Innovation, Neuchâtel 2016/2017
Higher Education and Research in Switzerland

Switzerland is a hub for excellent education, science, and innovation. It has outstanding universities with numerous programs, many world-class public research institutions, and a thriving private sector which encourages research and development. Higher education in Switzerland comprises universities, universities of applied sciences, and universities of teacher education. These institutions offer first-rate educational opportunities in diverse fields of study and they usually conduct research in an English-speaking environment. Swiss higher education follows the tiered study model of bachelor’s and master’s degrees. The universities also award Ph.D. degrees. Swiss higher education is largely publicly funded.

Universities
Switzerland has ten cantonal universities and two Federal Institutes of Technology. The two Federal Institutes of Technology are based in Zurich and Lausanne. Additionally, there are four affiliated research institutes within the Federal Institutes of Technology domain (not shown on the map): the Paul Scherrer Institute (PSI), which is a research institute for natural sciences and technology that runs several particle accelerators, the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL), the Swiss Institute for Materials Science and Technology (EMPA), and the Swiss Federal Institute of Aquatic Science and Technology (EAWAG). Swiss universities offer a diverse range of high-quality study options in all disciplines and fields of study. Many of them figure prominently in international university rankings. In 2016, the majority of Swiss universities were ranked among the top 200 in the Times World University Rankings.

Universities of Applied Sciences (UAS)
The universities of applied sciences focus mainly on applied research and development to serve the needs of the private sector, the cultural sector and the public sector. They enable the transfer of knowledge between research laboratories and the market. In so doing, they form an important link to the innovation chain. They are based in multiple locations and offer studies in a variety of fields such as:

- Design
- Economics
- Music, Theater, and Fine Arts
- Chemistry and Life Sciences
- Engineering and Information Technology
- Social Work and Health
- Architecture, Building Engineering and Planning
- Sports
- Agriculture and Forestry
- Applied Psychology
- Applied Linguistics

Universities of Teacher Education
Switzerland also has more than a dozen universities of teacher education with multiple locations in most cantons (comparable to U.S. states or Canadian provinces). The universities of teacher education combine practical training with applied research. They work closely with universities and universities of applied sciences and some of them are integrated into those institutions, which is why they do not appear on the maps as individual institutions.

Other Research Institutions
Switzerland also has a few specialized higher education institutions such as the Graduate Institute of International and Development Studies in Geneva and Swiss conservatories (some of which are integrated into UAS). A great deal of research is also conducted outside the higher education realm. Switzerland has a number of research institutions of national interest, for example, the Swiss Tropical and Public Health Institute and the Swiss Centre for Applied Human Toxicology, to name just a few. Furthermore, the Swiss National Science Foundation (SNSF) is Switzerland’s foremost funding organization for basic research.
Scholarships

There are several scholarships that offer financial support to U.S. and Canadian students interested in going to Switzerland for their studies or to do research. Most Swiss universities also have student exchange programs with U.S. universities and some of them offer their own scholarships to international students. The most prominent Swiss research scholarships for North American students are the ThinkSwiss and the Fulbright-Swiss Government Excellence Scholarships, which are open to students of all fields. ThinkSwiss has supported young researchers since 2007 and Fulbright-Swiss Government Excellence Scholarships have been available to U.S. researchers since as far back as 1961. Both scholarships are funded by the Swiss State Secretariat for Education, Research and Innovation (SERI).

ThinkSwiss

ThinkSwiss is a scholarship program managed by the Office of Science, Technology, and Higher Education (OSTHE) at the Embassy of Switzerland in Washington, D.C., that offers research scholarships and summer school travel grants to students from U.S. and Canadian universities.

Research scholarships offer financial support to students who wish to spend up to three months at a Swiss institution of higher education for a research internship. Summer school scholarships provide travel grants to students participating in selected Swiss summer schools. ThinkSwiss scholarships are open to students of all fields and all degrees as long as they have completed their sophomore year of undergraduate studies. The Embassy of Switzerland in Ottawa, Canada strongly supports the program and offers information for students from Canada. Presence Switzerland (PRS) also supports the program by organizing an annual 2-day trip for ThinkSwiss awardees.

Fulbright-Swiss Government Excellence Scholarships

Fulbright-Swiss Government Excellence Scholarships fund research stays for six to twelve months. For U.S. students and artists, the Swiss and U.S. governments collaborate to offer merit-based scholarships. These Fulbright-Swiss Government Excellence scholarships are offered through the Federal Commission for Scholarships for Foreign Students (FCS), also known as ESKAS (Eidgenössische Stipendienkommission für ausländische Studierende) or CFBE (Commission fédérale des bourses pour étudiants étrangers), and the U.S. Department of State's Bureau of Educational and Cultural Affairs.

The research scholarships are open to researchers in any discipline with a Bachelor’s or Master’s degree (or equivalent). Art scholarships are open to art students wishing to pursue an initial master’s degree in Switzerland. They are awarded for study at any Swiss conservatory or university of applied sciences. Fulbright-Swiss Government Excellence Scholarships are only available to U.S. citizens.
A research stay in Switzerland allows young scientists to become engaged in a diverse research community and to establish an international network. The ThinkSwiss and Fulbright-Swiss Government Excellence Scholarships also allow students at undergraduate level the opportunity to do research with leading experts. That exposure is a great starting point for a future academic career.

The following portraits of past awardees provide an insight into the range of possibilities and the merits of doing research in Switzerland. Their experiences range from patent filings for a cutting-edge innovation to collaboration with Nevada’s Governor’s Office of Economic Development. Many of the past awardees continued their studies as graduate and Ph.D. students, which led them to successful careers in and outside academia.
Neural engineering is a new field which involves the fabrication of implants that can help treat neurological disorders including Parkinson’s, epilepsy and blindness. The engineered devices interface with the brain or spinal cord, by providing electrical and chemical stimulation. An additional requirement is that the device must be soft and able to conform to the complex geometry of the nervous system without damaging the tissue.

Through my scholarship, I spent a year at the Federal Institute of Technology Lausanne (EPFL) in the research groups of Grégoire Courtine and Stéphanie Lacour. I worked on the design, characterization and fabrication of a novel device for the recording of brain points and limitations of the technique. The devices contain electrical sites which are used to deliver electrical stimulation to particular points in the brain.

Before I arrived at EPFL, there were limits on the number of electrodes that could be fabricated on each implant. One of my first contributions was to increase the number of sites in a scalable and reliable way, thus expanding the areas from which brain signals could be recorded. My technique also allowed for 100% yield of functional electrodes, compared to previous yields of around 60%. My second contribution was to introduce an alternative technique to fabricate soft neural implants. Working with a graduate student in the Lacour lab, we created a brand-new process which incorporated only clinically-approved materials. After months of optimizing the fabrication steps, we had our first proof-of-concept of this inherently stretchable device.

Since then, we have an approved license for testing the two technologies that I worked on. As the first step for clinical translation, these experiments will be done in large mammals. In addition to the output of 3 in-preparation scientific papers, we have filed for a patent for the alternative stretchable technology.

My stay in Switzerland confirmed my love for the world of neural engineering, and now that I’ve returned to Harvard to begin my Ph.D., I have been meeting with professors in Boston to continue the work I began in Switzerland. I aim to collaborate with my EPFL-based professors throughout my doctorate to further my contributions to the field of neural engineering.
According to legend, modern Swiss artist Paul Klee developed his distinctive artistic style in the sacred desert city of Kairouan in Tunisia. However, my experiences on the ThinkSwiss Research Scholarship showed me how the architecture of Klee's hometown of Bern influenced the ways he painted faraway places.

In fall 2010, I participated in Prof. Dr. Weddigens lively graduate seminar at the University of Zurich and conducted archival research at the Zentrum Paul Klee in Bern. The intellectual exchange with Swiss experts and access to original art from museum storage, unpublished letters, and rare exhibition reviews were invaluable for my Ph.D. dissertation on Klee's Tunisian watercolors. But just as important was walking the streets of Bern, as Klee himself had done more than a century ago.

Before traveling to Tunisia in 1914, the artist had reimagined the sixteenth-century buildings of Bern that are stacked high upon a peninsula as compositions of ascending colored squares. Klee’s Bernese architectural fantasies laid the foundation for his renowned watercolors of Tunis and Kairouan, in which the artist wrote that he had achieved a “synthesis of pictorial architecture and [built] architecture.”

Acclimated to the tightly controlled urban planning and grid-like organization of the streets of Bern, the meandering alleyways of Kairouan must have felt completely alien to Klee. Moreover, the artist encountered distinct visual hierarchies of the everyday and the divine in each city: in Bern, the Catherdal scars above the rest of the city, whereas in Kairouan, the mosques are level with secular structures apart from their domes and minarets. This likely gave Klee the impression that the spiritual is more integrated into the everyday. Reading travelogues, looking at maps and studying photographs cannot fully convey how one experiences the built environment. Moreover, had I not spent time in Bern, I’m not sure that I would have given as much thought to the broader significance of architecture for Klee’s painting.

Having completed my Ph.D. at Washington University in St. Louis in 2013, I now work as a Senior Art Consultant at ARCH Design, Artwork Framing in St. Louis, MO. I advise architects and interior designers on how to use art to create a sense of place in healthcare settings.

Paul Klee, Stadt mit den drei Kuppeln. Credit: Stiftung Im Obersteg, Depositum im Kunstmuseum Basel, Photo Credit: Martin P. Bührer
Botany Genomics and Adaptations of Tree Populations to Climate

Adriana Suarez-Gonzalez
2014 ThinkSwiss Research Scholarship Awardee (as a Ph.D. candidate)
University of Fribourg

"Learning and implementing innovative statistical and bioinformatics tools were valuable experiences."

Forests play a pivotal role as key drivers of economic growth and providers of a broad range of ecosystem services including carbon sequestration and biodiversity. Today, forests are increasingly threatened by a changing climate and maintaining the health of tree populations is particularly challenging. Genomics can help us develop an understanding of how tree populations have adapted in the past, and finding the genes that matter to adaption to climate will assist governments and foresters to create effective conservation and management policies.

Our collaborative research, between Lexer lab at the University of Fribourg and Douglas Lab at the University of British Columbia (UBC), identified genetic regions with signatures of adaptation to climate in black cottonwood (Populus trichocarpa) (Suarez-Gonzalez et al 2016). Black cottonwood is an ecologically and economically important forest tree distributed throughout the western U.S. and Canada, from California to Alaska, and the first tree species to have its genome sequenced. At the University of Fribourg, we implemented innovative statistical tools—initially designed for human genetics—and used the DNA of about 1000 trees.

The analysis revealed two key findings: correlations between genes in chromosome 15 and adaptive traits, and “alien” material in these genes. Trees with certain genetic variants in chromosome 15 showed higher chlorophyll levels which could indicate faster grow and higher carbon acquisition. The trees with these specific genetic variants were only found in the northern part of the range (Alaska), where fast grow could be beneficial to counteract shorter growth seasons (i.e., short summers). Additionally, these specific variants in chromosome 15 had genetic material from another species, balsam poplar (P. balsamifera). Falsam poplar is largely a boreal species with high frost tolerance and adapted to drier climates, while black cottonwood is adapted to relatively humid and mild conditions west of the Rocky Mountains.

Our genomic scans suggest that hybrid individuals, black cottonwoods with some balsam “blood”, may grow and acquire carbon faster than pure black cottonwood, and showcase a unique example of adaptive hybridization in trees.

I’m currently bringing innovation to market as the Customer Market Insight and Technology Transfer Manager for GenXys, a startup that offers pharmacogenetics testing and a medication decision support system.
Urban and Regional Planning
Road Traffic Emissions in Southern Switzerland

Benjamin VanGessel
2013 ThinkSwiss Research Scholarship Awardee
(as a graduate student)
USI Università della Svizzera italiana

"As an extension of this experience, I continue to tackle environmental issues."

In Europe, emissions from road transportation are growing, whereas emission trends remain steady or are decreasing for other sectors. Additionally, road traffic is a major source of air pollution that poses significant human health risks. As a participant in the ThinkSwiss program, I sought to identify potential mitigation strategies to reduce emissions from the on-road transportation sector in Switzerland.

Hosted by the Università della Svizzera italiana in Lugano (USI), my research largely focused on air quality concerns in Switzerland’s southern canton of Ticino. In Ticino, pollutants like nitrogen oxides (NOx) regularly exceed the limit of 30µg/m³ set by the Swiss Ordinance on Air Pollution Control. Both particulate matter and ozone-monitored readings in the valleys of Ticino were shown to be elevated well above the Swiss national average. The elevated measures are in part related to the topographic and meteorological conditions but are largely a product of increasing regional traffic volumes.

For this research, I examined macro trends of the Swiss on-road transportation sector including vehicle ownership, vehicle miles traveled, vehicle type sales, fuel expenditure, energy and greenhouse gas intensity of travel. I developed long-range projections at a cantonal level using a sketch model roughly based on the U.S. Environmental Protection Agency’s Motor Vehicle emissions Simulator. Long-term macroeconomic and behavioral trends in Switzerland indicated that, without intervention, air quality issues will worsen both within the Canton of Ticino and nationally. Furthermore, private vehicle use accounts for nearly 32% of Switzerland’s annual greenhouse gas emissions and is projected to grow.

From the sketch model, I examined the impact of various policy interventions to reverse or mitigate the trends. Reducing emissions requires a policy mix that addresses three areas. First, introducing a pollution price on certain fuels could begin to capture the externalities of transportation. Second, other efforts to promote lower emissions vehicles and fuels, such as electric vehicles, could tap into Switzerland’s already robust investment in clean energy generation. Lastly, travel efficiency measures, such as road pricing, could be employed to reduce overall transportation demand.

I am currently employed at the U.S. Environmental Protection Agency working with state and local transportation agencies to assess and reduce transportation-related pollution and greenhouse gas emissions.

Traffic in the Swiss Canton of Ticino. Credit: Ilaya831
Among Swiss cities and cantons, Basel has long remained distinctive. On the periphery at the crossroads of France, Germany, and the rest of Switzerland, its international trade relations, culture, and even linguistic separation from the other German-speaking cantons have together produced an impressively unique identity.

My research project in Switzerland queried older narratives of Swiss and Basel “abstention” from the ostensibly German approach to rigorous, critical scholarship (Wissenschaft) in the modern university. I focused on Swiss-German religious education in Europe’s revolutionary era by examining one of Basel’s nineteenth-century figures: Karl Rudolf Hagenbach (1801–74), prodigious poet, journal editor, writer, and professor of church history at the University of Basel for over five decades.

Hagenbach transformed the study of history and religion in the modern university through his pioneering textbooks, which recast the curriculum in novel ways. These works enjoyed unmatched success both within and beyond German-speaking Europe through their adoption as standard university texts for beginning students and their translation into Danish, Swedish, Dutch, English, Hungarian, Russian, and eventually Chinese.

Though often eclipsed today, Hagenbach’s influence was remarkable. As my research demonstrates, his work not only reshaped modern university theology on international and transatlantic levels, but also, paradoxically, drew him deeper into his Basel and Swiss context. As a key player in nearly all aspects of Basel’s political, social, and cultural life, he guided countless city and cantonal developments and spearheaded the modernization of Switzerland’s oldest university, founded by the humanist pope Aeneas Silvius Piccolomini (Pius II) in 1460, into a leading center of rigorous, critical scholarship in its own right.

Alongside the researchers I worked with, I am delighted to count Hagenbach’s descendants, still resident in Basel and active in the community, as close friends and collaborators, providing unparalleled access to family documents, patient help in deciphering the dialect, and insight into traditional events like Fasnacht and Vogel Gryff—even as I share my own traditions with them. Currently, I am a Leverhulme Early Career Postdoctoral Fellow at the University of Edinburgh in Scotland, UK. Fruits of my research in Switzerland appeared recently in print in my first book, *Theology and the University in Nineteenth-Century Germany* (Oxford University Press, 2016).
Ecology
Flies Can Predict the Future

Kristy Barnes
2015–2016 Fulbright-Swiss Government Excellence Research Scholarship Awardee
(after her undergraduate studies)
University of Bern

"The opportunity to conduct independent research as a young scientist was invaluable to my career."

Climate change is inevitable, yet many of the consequences remain unknown. Looking to previous climate shifts, scientists can begin to elucidate processes that influence the climate system and subsequent ecosystem changes. These connections can then be utilized to better understand the impacts of the current climate change.

During my time in Switzerland, I worked under leading experts at the University of Bern to learn how to use biotic proxies to reconstruct past climates. Using fossilized chironomids, known as non-biting midges, it was possible to create the highest resolution alpine paleoclimate reconstruction as of yet. Chironomids are good proxies because they are abundant, widespread, stenotopic, and sensitive to climate. Further, larvae remains preserve well in lake sediments and can often be identified to species level. Cores were collected from Gouille Rion, a lake located 2,343m a.s.l. in the Canton of Valais. The cores span from ~11,000 to ~2,000 calendar years before present. Contiguous samples of 1 cm² were taken, resulting in a total 120 samples to be processed (each sample covers ~50 years).

Using a microscope, I examined each sample, finding, removing, and identifying hundreds of chironomid remains. A transfer function, based off modern climatic constraints of chironomid species, was then used to determine temperature.

The preliminary results gathered are both complementary and contradictory to past reconstructions. Major events, such as the early Holocene warming and the general mid-Holocene cooling are seen in my data. The early Holocene warming, however, is both earlier and warmer than expected. While this may seem alarming, it does corroborate other studies done at high altitudes, and pollen data at Gouille Rion confirm the earlier, warmer transition. The data collected will help further understand the effect Holocene warming had at high altitudes, as well as the different ways in which the earth may experience future climate warming.

I am now at Vanderbilt University in Nashville, TN, pursuing a Master’s degree in Ecology. I am studying the interaction between large ungulates and soil nutrient dynamics.
As a second-year medical student, I was given the opportunity through ThinkSwiss to work with Dr. Christian Tempelín, a leading figure in cardiology in the study of Takotsubo Syndrome. Takotsubo Syndrome (TTS) is a heart condition that presents similarly to a heart attack but has no evidence of coronary artery occlusion. The condition gets its name from the distinct apical ballooning configuration of the heart’s ventricles that resemble a Japanese octopus pot when seen on an angiogram.

TTS is generally considered to be nonthreatening, with most individuals recovering full cardiac function, but the exact pathophysiology of the disease is still unclear. What is well recognized is that TTS is usually provoked by an emotional or physical triggering event, such as the death of a loved one, a car crash or a natural disaster.

Given that emotions have such a strong influence in triggering a TTS event, our group sought to study the relationship between mental health and TTS. To do so, we used data in the International Takotsubo Registry, founded by Dr. Tempelín’s team. The registry holds patient data from 26 centers in nine different countries and is the most expansive registry of its kind.

We compared a group of patients with a history of psychiatric disorders, such as anxiety and adjustment disorders, to a group of patients with no such history. Interestingly, patients in the psychiatric group were younger, more likely to be female, more likely to present with emotional triggers and more likely to have concurrent medical problems such as migraines and hypothyroidism. The long-term outcome of the psychiatric patients was significantly worse, with a much higher 10-year recurrence rate than the non-psychiatric TTS patients. Given these conclusions, it’s very important that TTS is differentiated from other acute coronary syndromes upon presentation.

I am currently finishing my third year of medical school in Chicago, Illinois and will be applying to residency programs across the United States. Since my stay in Switzerland, I changed the focus of my studies from cardiology to otolaryngology but the research skills I gained in Zurich are invaluable to my career in academic medicine.
Biology
Genetic Diversity across Space and Time

Mark Szenteczki
2014 ThinkSwiss Summer School Scholarship Awardee
(as an undergraduate student)
University of Lausanne

“While the species I’ve studied have varied over the years, one element that connects them all is Switzerland.”

Few things excite me as much as influences on genetic diversity across space and time, and the current pace of technological innovation. I’m lucky to have been able to combine these interests, as a field biologist with a penchant for overly technical solutions to questions in ecology and evolution.

Much of my past, present, and future research involves Switzerland—and it all started with a ThinkSwiss travel grant, for the 2014 summer undergraduate research program (SUR) at the University of Lausanne (UNIL). While at UNIL, I combined North American snakes (specifically, eastern and western foxsnakes) with leading-edge Swiss research facilities.

Our project surveyed genetic variations in foxsnakes across 20,000 loci, using restriction site associated DNA sequencing (RADseq). This project gave us a higher resolution overview of the distribution of foxsnake genetic diversity across Canada and the U.S. It also confirmed that the eastern and western lineages, which are separated by a large range disjunction, are likely two distinct species (cf. figure below).

I kept in touch with my SUR project supervisor (Dr. Nadir Alvarez) after returning to Canada, and we designed an interesting MSc project on large blue butterfly (Maculinea alcon) caterpillars. We were awarded a UNIL Master’s Grant for the project, and I was back in Lausanne in 2015! My MSc project focussed on the microbiomes of large blue butterfly (Maculinea alcon) caterpillars, and their ant hosts.

Thanks to world-class facilities, excellent support, and an incredible environment (both in and out of the lab), we have been able to advance our understanding of all these species, and ultimately protect their genetic diversity and adaptive potentials in a changing world. We recently completed my MSc project, and I’m happy to report that I also accepted an SNSF (Swiss National Science Foundation) doctoral fellowship position! Now, we are studying the chemical and molecular ecology of Arum maculatum, a plant with a unique “deceptive” pollination strategy.
Design
Emotional Investment in Virtual Reality

Rebecca Goodine
2016 ThinkSwiss Research Scholarship Awardee
(as an undergraduate student)
Zurich University of the Arts

"If anything from this experience is certain it is that I have grown: academically, personally, and culturally."

While attending the Zurich University of the Arts, I was involved in research looking at emotional investment in the context of played Virtual Reality experiences. I held playtesting sessions where I asked my participants to play the VR game, “Sightline: The Chair,” during which I asked them questions about their in-game perceptions.

These questions centered on two key topics, emotion and bodily sensation, in order to investigate my hypothesis that VR embodiment could elicit emotion in ways unique to that medium. I then attempted to codify these answers across participants to see where common thematic areas occurred in their verbal answers. My small sample size did not yield enough data to make significant quantitative predictions or statistical observations; however, I did find some qualitative areas of commonality, such as a reported uncomfortableness when the in-game avatar did not match the player’s real life body, which is certainly an area I am interested in considering with future and larger-scale research.

My interest in this particular project, and in games studies in general, stems from my wish to understand why and how videogames can make us feel the way we do. From a young age I was drawn toward games, and today I believe that the wholly engrossing “magic” which I saw in them is something that can be refined to help a variety of individuals, such as those with emotional or mood disorders.

I am extremely grateful to ThinkSwiss and my hosts (Zurich University of the Arts and Dr. Beat Suter) for this opportunity to explore my research interests, an opportunity which has since proven to be an invaluable source of inspiration personally. In fact, I think a combination of working in the lab, being exposed to a multitude of fantastic thinkers and being given the tools and freedom to work on my interests are what collectively inspired me to apply to a graduate program for fall of 2017.

I have now been accepted to a Master’s program position with the Concordia University of the Arts in Montréal, Quebec, where I will be studying in their MDes program.
Computational Chemistry
Groundwork to Manufacture Synthetic Analogs of Enzymes

Danil Kaliakin
2015 ThinkSwiss Research Scholarship Awardee
(as a Ph.D. candidate)
ETH Zurich (Federal Institute of Technology Zurich)

“My research project at the ETH Zurich was exciting,
enjoyable and greatly beneficial to my growth as a chemist.”

My research in Switzerland focused on the computational study of the difference in kinetics of superoxide formation for sulfur and selenium species of cytochrome P450cam. This compound is a heme iron enzyme, which plays a crucial role in a broad variety of reactions involved in biological metabolism, such as the synthesis of steroid hormones. Formation of superoxide on the active site of P450cam is the crucial step in these reactions, thus the understanding of these mechanisms is essential for the manufacture of synthetic analogs of the P450cam active site.

At the Federal Institute of Technology Zurich, I studied the transitions between the electronic spin states with different multiplicities in the active site of P450cam and the selenium-substituted P450cam in Prof. Markus Reiher’s group. The multiplicity of the electronic spin state represents the number of unpaired electrons within the system, where each unpaired electron has the spin (S) equal 1/2 and the multiplicity is defined as 2S+1. The research group demonstrated that at certain distances between the P450cam active site and superoxide the energies of quintet/septet and singlet/triplet electronic spin states become degenerate (equivalent), which could potentially lead to transitions between these electronic spin states.

To find the geometries at which these transitions become possible, the research group initially performed the screening along the distance between iron (Fe) and superoxide that was followed by geometries optimizations at each given distance between Fe and superoxide. During these geometries optimizations, the distances between Fe and superoxide were constrained to specific values. I performed the unconstrained geometry search of transition geometries with the algorithm that simultaneously accounts for not only the change in distance between Fe and superoxide, but also distances and angles between other atoms within the system.

We demonstrated that the transition geometries that were found during my calculations are consistent with earlier calculations. We managed to get the data that further prove the possibility of transitions between the electronic states with different spin multiplicities within the P450cam active site and the selenium-substituted P450cam, which could be helpful in future development of new bio-inspired catalysts.

I graduated with a Ph.D. in Chemistry in May 2017 from the University of Nevada, Reno. Currently I am working here as a research assistant, so I can finalize my research projects before starting my postdoctoral research appointment this fall semester.
Social Sciences
Preparing Young People to Job Hop

Alexandra Ellison
2015 ThinkSwiss Research Scholarship Awardee
(as a graduate student)
University of Basel

"I couldn’t have predicted that my research trip to Basel would have been of any use or interest in Nevada."

My research in Switzerland revolved around understanding the dual education system there. I began to see very clear connections with and applications to the growing manufacturing industry in my home state. I also received a few words of warning from experts in Switzerland, warning against one-sided curriculum change, which can result when a large company begins to mold the educational standards to meet their own needs.

My research focused on the politics, policies and strategies behind dual education in comparison to the United States. During my meetings with administrators and the collection of interviews from the private sector, I began an internal debate, comparing the value of purely academic endeavors and the trades. I considered the appropriate balance of the two, the value of a 4-year Bachelor degree, the level of respect given to individuals in the trades and the best way to prepare young people to pivot and be flexible in a fast-paced and ever-changing world.

I began my research thinking vocational education was limiting, but later realized the 70% of young people in Switzerland who choose to pursue vocational education are in fact better prepared to pivot and “job hop” in the future. Switzerland has figured out a way to allow multiple learning pathways without limiting students’ opportunities or future earning potential.

In January 2016, I gave a talk at TEDx University of Nevada entitled “Educating the Next Generation of Job Hoppers.” In this talk, I discussed my research in Switzerland and what the U.S. could gain from a better appreciation for and application of a similar Dualbildungssystem.

My research experience in Switzerland has turned out to be much more relevant than I initially thought. It seems that my timing was also perfect, given the current educational and economic climate in my state. I recently proposed a new work-based learning experience for northern Nevada, bringing in partners like the high school, the community college, the Governor’s Office of Economic Development and a private community foundation. I now own an educational consulting practice called Dunce Labs where we give educational guidance to high school students.
Acknowledgments
We would like to thank the ThinkSwiss and Fulbright-Swiss Government Excellence Scholarship recipients for sharing their experiences.

Sources
Swiss State Secretariat for Education, Research and Innovation SERI (2017): Higher Education and Research in Switzerland

Design and Layout
Visual Communication FDFA, Bern, Switzerland

Credits
Author and Project Manager: Sophie Baumann
Editor: Cheryl A. Fain
Content and Review: Swiss State Secretariat for Education, Research and Innovation SERI
Review: Simon Marti

Printing
Gabro Printing & Graphics, Sterling, Virginia

More Swiss Scholarships Online
Visit our blog to read about the most recent ThinkSwiss scholars: www.thinkswwiss.tumblr.com
Download this brochure and other material from our website at www.swissemb.org/scitech

More Swiss Knowledge Contacts in the United States and Canada
Embassy of Switzerland in Canada: www.eda.admin.ch/ottawa
swissnex Boston: www.swissnexboston.org
swissnex Boston New York outpost: ny.swissnexboston.org
swissnex San Francisco: www.swissnexsanfrancisco.org

Washington, D.C., June 2017