

Not just Fundamental Research: Education, Equal Opportunities, Knowledge and Technology Transfer, and Communication at the NCCR Bio-Inspired Materials

Scott Capper^a, Eliav Haskal^a, Andreas Kilbinger^b, Lucas Montero de Espinosa^a, Barbara Rothen-Rutishauser^a, Curzio Rüegg^c, and Christoph Weder^{*a}

Abstract: Besides conducting excellent fundamental research in domains of strategic importance, the National Centers of Competence in Research (NCCRs) also aim to become centers of reference for education, equal opportunities, and knowledge and technology transfer. These activities are supported by a communication strategy focused on specific target groups. This article describes some of the main strategic goals and achievements of the NCCR Bio-Inspired Materials, presents the main activities launched by the Center throughout its first funding phase, and provides a glimpse of new plans and directions for the second phase.

Keywords: Communication · Education and Training · Equal Opportunities · Knowledge and Technology Transfer

1. Education and Training

The strategy of the NCCR Bio-Inspired Materials with respect to education and training spans all educational levels from elementary school to the professorial level. It has the overarching goals of providing students and researchers with skills that enable them to solve highly complex interdisciplinary problems while preparing them for successful careers in science and engineering. At the elementary and high school levels, the goal is to spark the interest of the students in science while contributing to their education. To this end, our Center carries out a number of self-organized outreach activities, and leverages many others that are initiated by the University and the canton of Fribourg. Some of the activities in which the Center participated in Phase 1 include the University of Fribourg's KidsUni and Scientific Afternoons, the National Future Day, school visits, mentoring high school capstone projects, and the Study Week of the Schweizer Jugend Forscht Foundation, which altogether served to reach over 500 students. At the tertiary level, our Center offers new interdisciplinary education and training opportunities in the domain of 'soft materials', supports the career development of PhD students and postdocs, and promotes the careers of pre-tenured researchers. Several programs were launched in Phase 1, among them, a new Specialized Master of Science in 'Chemistry and Physics of Soft Materials' at the University of Fribourg in 2016, which was implemented in collaboration with the Adolphe Merkle Institute. This unique interdisciplinary curriculum in the field of soft matter bridges chemistry, physics, biology as well as materials science and engineering. A very successful initiative of the Center is the Undergraduate Research Internships Program, which allows up to 20 undergraduate students from around the world to spend 12

weeks working on their own research project within one of the NCCR laboratories every year (Fig. 1). This program has helped connect the NCCR with top international universities, including MIT, Cambridge, Stanford and Harvard, led to new scientific collaborations, and provided a return investment in the shape of students coming to Switzerland for their PhD studies. As targeted, the program has helped to nucleate significant research collaborations, most notably a large PIRE project (Partnerships for Research and Education) in which twelve US professors from Case Western Reserve University in Cleveland (OH), the University of Chicago, the University of San Diego, and the University of Delaware, six NCCR professors from the Adolphe Merkle Institute, and fifteen PhD students collaborate on research and education in the domain of bio-inspired materials and systems.

Two other impactful programs launched by our NCCR are the International Graduate Exchange (IGE) Program and the Independence Grant. The IGE allows the Center's PhD students to spend several months working in a laboratory abroad, provides additional opportunities to establish new research collaborations, and creates visibility for the NCCR. The program is mainly driven by the PhD students themselves, who identify a host and write a research proposal. The Independence Grant supports postdocs and senior researchers who are pursuing an independent academic career, by providing funds for activities that extend beyond their work as NCCR participant. In order to respond better to different needs, this grant is flexible, and can be used to cover the costs of, for example, feasibility studies for personal projects, travelling for networking, or time allocation for grant writing. Further training organized by the NCCR include workshops on transferrable skills, research exchanges of participants among the groups of

*Correspondence: Prof. C. Weder
E-mail: Christoph.weder@unifr.ch

^aAdolphe Merkle Institute, University of Fribourg, Chemin des Verdiers 4, CH-1700 Fribourg

^bDepartment of Chemistry, University of Fribourg, Chemin du Musée 9, CH-1700 Fribourg

^cSection of Medicine, University of Fribourg, Chemin du Musée 8, CH-1700 Fribourg



Fig. 1. The participants of the 2018 Undergraduate Research Internships came from universities in the United States of America, the United Kingdom, Spain and the Netherlands.

the Center, mentoring of PhD students and postdocs and grant writing support.

The success of Phase 1 is reflected in the excellent post-NCCR employment statistics, which show that all collaborators found a job either in academia (55%), industry (38%), or the public sector (7%). Five senior researchers secured tenure-track faculty positions in the UK, USA, France and Japan. During Phase 2, the Center will continue all its educational and training activities, implement new measures to maximize their impact and attract Swiss students to the summer internships, and consolidate the Master program.

2. Equal Opportunities

Female scientists are still underrepresented in leading functions in academic and industrial research. The key problem is illustrated by the fractions of female and male students and researchers at different levels in the Faculty of Science of the University of Fribourg (as of May 2018, Fig. 2). While the fraction of female PhD students (41%) is only slightly lower than that of male students, the percentage of women decreases at the postdoctoral level (32%) and beyond (25% at the senior researcher level and 13% at the professorial level). The vision of the NCCR Bio-Inspired Materials is to offer and promote equal opportunities (EO) for all participants, as well as establish itself as a best-practice model for the advancement of young (female) scientists and the integration of women in natural and life science disciplines. The overarching aims are to provide outstanding and equal boundary conditions for all researchers, and to increase the participation of women in all functions of the NCCR.

Because the most effective way to fight gender bias is to address it at the very first stages of the education chain, one of the

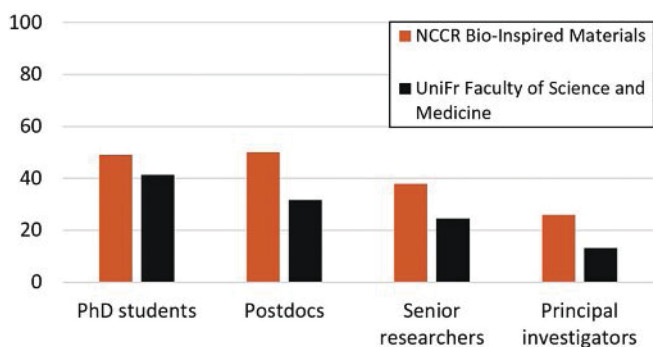


Fig. 2. Percentage of female scientists in the NCCR Bio-Inspired Materials (November 2018) and of the University of Fribourg's Faculty of Science and Medicine (May 2018).

NCCR's priorities is to create role models in teaching. To this end, female NCCR PIs and researchers participate in educational programs such as the TecDays in Swiss high schools organized by the Swiss Academy of Technical Sciences, and the University of Fribourg's KidsUni and Women in Science and Technology programs, in which they serve as role models for elementary and high school students at an early stage of their career. At the researcher level, our Center makes every effort to help those participants with family duties to reach a family-work balance. Thus, all meetings and seminars are scheduled during normal working hours and part-time work is encouraged when desired and possible. Additionally, and to avoid potential gender bias when hiring, our Center covers the non-reimbursed fraction of maternity leave.

Our NCCR further reserves and finances two slots at the University of Fribourg daycare center for its researchers, and makes funds available to cover extra childcare costs during travel to a professional event. Another very successful initiative are the round table discussions, which take place every two months, and bring in invited role models on career relevant topics such as negotiation, recognition of gender bias, or funding opportunities. Besides these activities, the Center's EO Faculty Delegate offers mentoring for young female researchers who wish to plan their scientific career.

One of the Center's EO key programs is the Postdoctoral Fellowships for Women in Science to support the professional development of outstanding female researchers. These grants are awarded to a female scientist once per year through an open call on a competitive basis. The grantees are hosted by an NCCR group of their choice and receive funds to cover their own salary, research consumables and travelling expenses for a period of two years. The Center offers further support to its female researchers for grant writing through the research promotion services of the University of Fribourg, and promotes in a wider sense the research by female scientists through sponsoring of conferences, or of symposia within conferences, that highlight female researchers.

The measures outlined above and the strong commitment of our Center to equal opportunities were recognized by the SNSF, who highlighted our EO program as an example of best practice of the 4th series of NCCRs. This recognition is validated by a recent internal survey in which 92% of the female researchers of our Center declared that they are satisfied with their family-work balance. Moreover, our personnel statistics show a high fraction of female researchers at all levels as compared to the University of Fribourg's Faculty of Science and Medicine (see above). Currently, 49% of PhD students, 50% of postdocs, 38% of senior researchers, and 26% of professors are women (Fig. 2).

As part of our new initiatives for Phase 2, the NCCR recently launched the EO Envoy Program with the objective to expand some of the successful activities beyond the NCCR. This program seeks to make an impact on the EO practices of the participating departments at the University of Fribourg, EPFL and ETHZ through the so-called EO envoys, who initially will be our NCCR PIs. The role of the EO Envoys will be to engage in conversations with the respective department heads to analyze which EO activities from the NCCR could be best applied in their departments and to help with their implementation. At first, these efforts will focus on the roundtable discussions and daycare subsidies since those two activities have been judged positively by all Center participants. Other activities such as grant writing support and personal coaching of talented researchers will be considered next. This strategy will be complemented by the active dissemination of successful measures *via* thematic flyers, interviews in local and national newspapers, and sharing of success stories with other NCCRs and EO Offices at Swiss universities.

3. Knowledge and Technology Transfer

Knowledge and technology transfer in the NCCR Bio-Inspired Materials targets the integration of fundamental and application-

oriented research to advance the understanding of scientific principles and simultaneously stimulate innovation, support industrial collaborations, and improve quality of life through novel solutions. This vision is supported with four main activities, for which many new programs were started in the last four years.

The first of these four activities is the internal knowledge transfer between the NCCR's academic participants. This goal is facilitated by events such as the NCCR's annual center two-day conference, which brings together all NCCR members, industrial partners, and external invited speakers. In addition, the NCCR implemented an internal student exchange program (where PhD students work in partner labs to stimulate joint research), NCCR lab visits and a seminar series. The second focus is on external knowledge transfer through scientific communication, including public outreach. To this end, multiple international conferences were organized, and several special journal issues and a book were published; moreover, a new trilingual exhibit on bio-inspiration at the Fribourg Museum of Natural History (entitled 'Inspiration Natur-e', Fig. 3) was designed and curated. Other outreach events include the AMI open door day (>1500 visitors), Zurich Zoo exhibitions, Science Slams, and Expo Nano 2015. The third main activity involves the transfer of technology to industry and/or spinoff company creation. In this regard, the NCCR contributed to significantly increasing industrial contracts and technology-transfer related funding at the University of Fribourg, and enabled five embryonic companies that have all received multiple awards and grants. Finally, the fourth main activity is intended to improve the innovation culture through teaching, training, and stimulation of interdisciplinary collaborations. Innovation sensitization activities such as entrepreneur seminars, an interdisciplinary NCCR collaboration with the local universities of management and engineering in Fribourg on innovation events and Masters projects, and a new master's course on innovation were undertaken.

Looking to the next four years, the challenge will be to maintain momentum of the NCCR collaboration that has been successful in achieving scientific and innovation results. In addition to the events described above, new conferences including an international self-organized conference on bio-inspired materials will be held, workshops on career options, design thinking, innovation training and soft skills, new public outreach events including shipping of the natural history museum exhibit to the USA, and participation in expos and trade fairs. For technology transfer and innovation, a Proof-of-Concept grant program will continue with seed funds for technological development of research ideas, and a new course on innovation will be proposed.

4. Communications

Communications, while often cited as a core activity and a necessity for any research program, exists in a support role to promote the work of others. The NCCR Bio-Inspired Materials is no exception, seeking to extend the impact of its scientific work beyond its own specific community. While the researchers themselves can discuss and debate their work with their peers, reaching other stakeholders such as policymakers, funding agencies, and the general public, requires a variety of channels in today's world.

Traditionally, communicating with the wider public has relied on a mix of press releases, media contacts, and outreach activities. This has not fundamentally changed, in the sense that during its first years of existence, the NCCR Bio-Inspired Materials has figured regularly in different media in collaboration with its partner institutions either through its research activities or events it supports (Fig. 4). This has led, among many other things, to a story about how flowers have a blue halo that attracts bees being featured in the *Guardian* or the *Atlantic*, or local media coverage about a roundtable with the US ambassador. The other major communications tool for all NCCRs is a regular activities report, aimed squarely at scientific peers and policy makers, of which our Center has produced three so far highlighting both our research as well as our widely-commended equal opportunities, education, and innovation initiatives. The Center's communications also take an active role in promoting these initiatives through marketing and promotion, either on the ground at fairs and conferences, or online.

For anyone seeking to know more about a program such as the NCCR Bio-Inspired Materials, a website is the obvious first stop for news and information. The Center's site, now in its third iteration, integrates norms such as responsive design, and dynamic pages fed by a bespoke database linking publications, projects and people. This has been completed by the development of social media platforms – Facebook, Twitter, and LinkedIn. While the first two allow for a less formal presentation of the Center's many activities, or more light-hearted information, the third is intended to leverage the professional network of staff and stakeholders, the all-important connections. The social media approach has also allowed many staff to take their first steps in communicating science. The NCCR Bio-Inspired Materials is also involved in multiple outreach activities, putting faces and names to the research. Staff have taken part in or helped organize events such as science slams, the museum night in Fribourg, the Zurich Zoo's Going wild! days, the MIT European Job Fair in Boston, or the current Inspiration Natur-e exhibition at the Natural History Museum in Fribourg, events that are typically echoed *via* the Center's different communications channels.

This combination of physical output, online presence, and active participation in events, has allowed the Center to extend its impact well beyond its natural sphere of influence. It plans to continue doing so, with the goal of proving its very real impact towards the improvement of our society.

In conclusion, the activities of the NCCR Bio-Inspired Materials in Phase 1 have expanded well beyond fundamental research and helped connecting the Center to the different actors of

http://doc.rero.ch



Fig. 3. The Fribourg Natural History Museum exhibition 'Inspiration Natur-e' was designed and curated with the NCCR Bio-Inspired Materials.



Fig. 4. The activities of the NCCR Bio-Inspired Materials have been highlighted through various media channels. Some of the NCCR's bio-inspired research was featured on the Swiss Italian public television (RSI).

society, from the general public to the industrial and public sectors. Some of the programs launched, like the research internships for undergraduate students, the postdoctoral fellowship for women in science, the childcare support or the proof-of-concept grant have already proven very successful, while the impact of other longer-term initiatives such as the new Master program or the equal opportunities envoys program will only be revealed through Phase 2 and beyond. Overall, the past achievements, ongoing projects, and future plans of the Center in the above discussed strategic areas are a solid standpoint from which our Center faces the challenges and opportunities of the following years.

More information on the activities of the NCCR Bio-Inspired Materials can be found on its web site (www.bioinspired-materials.ch), as well as on the social media platforms Facebook (www.facebook.com/bioinspiredmaterials), Twitter (www.twitter.com/NCCRBioinspired), and LinkedIn (www.linkedin.com/company/nccr-bioinspired-materials).

Acknowledgements

The activities discussed in this article were carried out with financial support from the Swiss National Science Foundation (SNSF) and from the University of Fribourg within the frame of the National Center of Competence in Research (NCCR) Bio-Inspired Materials.