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Chemistry is a Fundamental Element for Novel Education in Molecular Life Sciences

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Abstract: Chemistry is a science and an art. But it is not art for art's sake. Increasingly, chemistry is being used as a fundamental knowledge base to further innovations in bordering disciplines such as biology or medicine. At the School of Life Sciences in Muttenz, chemistry has this dual role. Chemists and chemical engineers alike can study chemistry in a bachelor curriculum. In addition, this course is now complemented by an option in molecular bioanalytics. This design complements the steady increase in applied research and development in such areas as diagnostics, screening or biomonitoring undertaken at Muttenz. Strengthening knowledge in molecular life sciences while maintaining a rigorous education in chemistry is central to making students fit for the modern workplace. They will be able to perform well in such diverse fields as biological or pharmacological chemistry, chemical biology or (bio)chemical engineering.

Keywords: Applied research and development · Bachelor of Molecular Life Sciences · Chemistry · Education · FHNW · Innovation · Molecular bioanalytics · School of Life Sciences Muttenz

Introduction

The hierarchy for the generation of scientific knowledge is unchallenged. The fundament for all insight is formed by mathematics. Physics uses mathematics to define what keeps the material world together. And chemistry, finally, applies physical laws in order to understand how matter, molecules and chemical structures are formed and transformed.

These three fields, mathematics, physics and chemistry, undoubtedly formed the basis for the stunning achievements in the biological and biochemical sciences in the last century. Be it the elucidation of the DNA structure 50 years ago, the identification of restriction enzymes or the development of whole genome sequencing machines, physical and chemical excellence was always at the heart of technological breakthroughs.

But knowledge is evolving rapidly. Novel fields in science use existing knowledge and apply proven expertise to overcome existing hurdles in neighboring areas. The boundaries between fields have thus become permeable. Complex technical applications are increasingly the result of bringing together knowledge from various scientific disciplines. Fields such as chemical biology, nano-chemistry or biomedical chemistry, to name but a few, are trends and promising offspring of 'traditional' chemistry.

An education which aims to provide young scholars with both a strong fundament as well as a tool kit for being able to further the good of humankind and nature, must, therefore, do two things. First, it must provide a thorough education in chemistry. Second, it must strengthen the competence to fuse and merge this knowledge with fields such as biology, physiology or medicine. The new School of Life Sciences in Muttenz, which is currently being developed, can stand as an example for this strategy. It shows how chemistry is used as a fundamental element to make its students fit for the modern and complex biomedical professions.

The School of Life Sciences in Muttenz

Chemistry has a long tradition in Muttenz. It dates back to the School of Engineers when chemical engineers were continuously educated in chemical syntheses, analytical chemistry and engineering technology. Since 1997 the University of Applied Sciences has offered a full-time education in chemistry with a bachelor as final degree. In 2005, this University was

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reorganized to become the School of Life Sciences, a part of the new University of Applied Sciences of Northwestern Switzerland. Beginning this fall, it will now offer two new bachelor courses, one in Life Science Technologies and one in Molecular Life Sciences. Students can still major in chemistry in the molecular life sciences course. The novelty is now that one can also major in molecular bioanalytics.

Molecular Bioanalytics Complements Chemistry

The novel extension of molecular bioanalytics comes as no surprise. Over the last decade, the number of biotechnological courses and projects has risen steadily. This development parallels the evolution of the pharmaceutical industry. In both instances, the methods used for generating knowledge in diagnostics, pharmacology or toxicology increasingly rely on biotechnological knowledge. In Muttenz, applied research in bioanalytics and diagnostics has even led it to becoming an effective competence centre in recent years. Several projects, carried out in-house, in collaboration with other universities, or with the SwissBiotechnet (see *www.swissbiotechnet.ch*), testify to this. Therefore, it is only logical to complement the research in this field by a formal education in molecular bioanalytics.

What is Molecular Bioanalytics?

Molecular bioanalytics contributes to biomedicine. It deals with the specific challenges posed when trying to understand the molecular basis of illnesses or abnormal biological conditions. It identifies and assesses suitable markers that are diagnostic or prognostic for such conditions. The methods used, thus, are often combinations of chemical, biochemical, immunological, genetic and cellular assays and tests.

Chemistry as a Basic Value

In the new curriculum, chemistry is not an added value. It is much more. It is a fundamental realm of knowledge, which one needs to be familiar with in order to understand the basic features or molecules, be they small or complex. Yet, at the same time, students will have to learn to invest these basics to develop imaginative and innovative applications, to for example screen biological systems or to diagnose and, in the end, hopefully treat harmful medical conditions. Synergies between chemistry, biology and biotechnology are sought and should materialize in excellence in drug chemistry, biochemical diagnostics, (bio)chemical engineering, biomonitoring and many related areas.

Added Value of Education in Molecular Life Sciences

Not long ago, one could define the global pharmaceutical giants as the ones producing small molecules. Yet, today, 'Big Pharma', too has both small and complex and large molecules in its portfolio. Biotechnology, often through collaborations with smaller biotechnological companies, is a driver of innovation. Knowledge of molecular biology is thus needed to strengthen chemical investigations. Only by combining this knowledge will today's students be fit for the ever changing and ever more complex research and work-place. A large part of the bachelor education including the diploma thesis, thus is also reserved for practice oriented project work.

By complementing chemistry with molecular biology and microbiology to form the Molecular Life Sciences curriculum, we will ensure that students become highly skilled. They will be able to perform well in research, development, certification, quality management, risk management, engineering or, last but not least, chemistry.

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