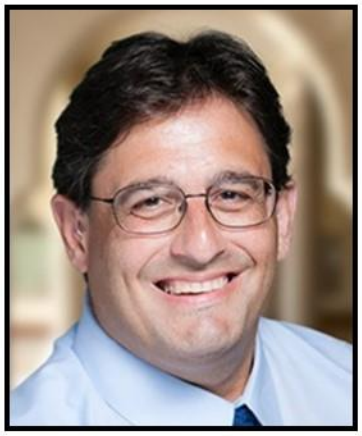
PLENARY LECTURE 4

NATIONAL PROGRAM ACCREDITATION - DOES IT HELP DRIVE CHANGE AND SUPPORT FACULTY & STUDENTS OR LIMIT OUR CREATIVITY?

PROF. JOSEPH PROVOST

University of San Diego
UNITED STATES OF AMERICA

Accreditation of academic programs and recognition of student degrees provide academic institutions a measure of a set of community agreed upon standards. These can aid pedagogical change, support faculty to successfully engage students in their discipline and to provide a mechanism to maintain standards. Several professional scientific societies from engineering, chemistry, and biochemistry and molecular biology have developed standards by which departments can be recognized for accreditation. As one of the members of the American Society for Biochemistry and Molecular Biology (ASBMB) who helped develop the accreditation and standardized exams and a committee member of the American Chemical Society's Committee on Professional Training (ACS CPT) I will present the evolution of the accreditation process, discus the benefits and challenges with being an accreditation. How these programs serve their communities and at times can hinder or be used to support potential creativity and teaching pedagogies will also be discussed.



Joseph Provost, PhD, joined the University of San Diego, where he now serves as Chair, after several years at Minnesota State University and on the leadership team developing biotech/pharma companies and innovation at North Dakota State University. Dr. Provost earned his doctorate in Biochemistry and Molecular Biology at the University of North Dakota School of Medicine and was a HHMI postdoctoral fellow at Vanderbilt Medical School. He has taught a wide range of chemistry and biochemistry courses and is interested in how to bring novel pedagogies of engagement into the classroom and teaching laboratory. Provost has been involved in other leadership positions in a number of organizations involved to enrich the experience of undergraduates including the American Society for Biochemistry and Molecular Biology (ASBMB) where has been the Chair of the Student Chapters and for served 14 years on the ASBMB Educational and Professional Development committee. In addition, Provost is in his second term on the American Chemical Society (ACS Committee for Professional Training - accreditation), served three terms on Council on Undergraduate Research (CUR) and has been involved as a mentor for the Project Kaleidoscope leadership institute. Provost's research focuses on cancer cell motility, tumor progression, and lung fibrosis. Provost has hosted and given numerous workshops on integrating research into the curriculum.

PLENARY LECTURE 5

BIOSCIENCE EDUCATION 2030 AND BEYOND: WHERE WILL TECHNOLOGY AND AUTOMATION TAKE THE CURRICULUM?

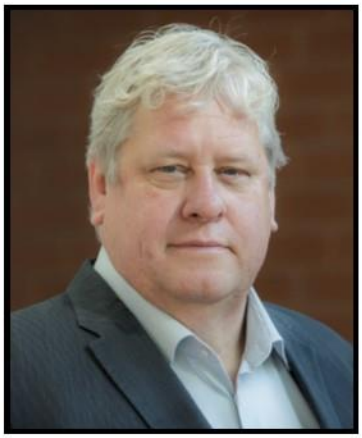
PROF. PHILIP PORONNIK

The University of Sydney
AUSTRALIA

We are now well into what the World Economic Forum calls the 4th Industrial Revolution. Dramatic technological advances are merging the physical, biological and digital worlds in ways that will change the way that we live. It is a world where creativity and empathy will complement the algorithms and where learning is no longer just about knowledge and content, but also about skills and experience. As the workplace becomes increasingly automated and augmented by artificial intelligence, it places growing emphasis on creativity and specialised, very sophisticated disciplinary understandings. Our graduates will be expected to be creative and co-create innovative problem solutions together with others who don't have similar deep disciplinary knowledge and/or experience.

The great challenge is that we struggle "teaching" these skills and our students similarly struggle "learning" them. Furthermore, we are often not confident in embracing the new technologies that the next generation students will be bringing to our places of learning. This presentation will explore the concept of interdisciplinary mutual learning and teaching, where students are co-creators of knowledge-driven innovations together with academics. Real-world "in-house" problems and are presented and students design and perform their investigations in collaboration with mentoring experts across the institution and related sectors. Emphasis is placed on effective interdisciplinary communication through mastering methods and tools of 'team science'.

Examples will be provided where we have focused on exploring ways to teach 21C skills to cohorts from large (>1500) first year classes to third year with ~300 students. We have developed a number of novel teaching approaches that address issues such as coding literacy, data collection using Arduino-based sensor devices, data interpretation, visualization and sonification as well as virtual, augmented and mixed reality technologies – activities that span the digital literacies and creative fluencies.



Philip Poronnik is a Professor of Biomedical Sciences (Educational Strategy) and Payne-Scott Distinguished Professor in the Faculty of Medicine and Health at the University of Sydney. He is also the Chair of the National Committee on Biomedical Science of the Australian Academy of Science, co-leader of the Bioscience Education Australia Network and Treasurer of the Federation of the Asian and Oceanian Physiological Societies. In addition to his ongoing molecular research, he is also studying the use of mixed realities in medicine and education. He has a long-standing interest in creativity and student engagement in the science curriculum along with a strong passion and commitment for transformation and excellence in science education. The National Committee that he chairs has recently initiated a vision statement for Bioscience Education 2030 that seeks to define the key capabilities and skills that students will need to master to make meaningful contributions in the decades to come.

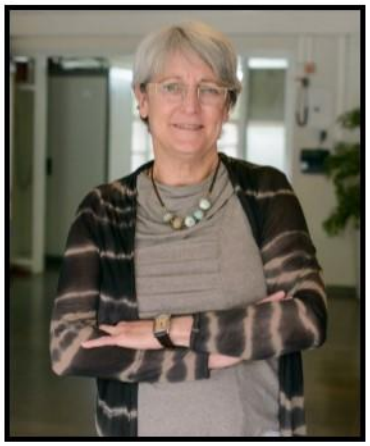
PLENARY LECTURE 6

USING A MOLECULAR VIEWER FOR LEARNING ABOUT PROTEIN STRUCTURE AND FUNCTION IN HIGH SCHOOL

PROF. ANAT YARDEN

Weizmann Institute of Science Israel
ISRAEL

One of the central practices of biochemists is using various molecular viewers, such as Jmol, for molecular modelling of proteins. Through Jmol, high-school biotechnology majors in Israel are visualizing molecular models of proteins through the mediation of computerized tasks, as one of the requirements of the biotechnology curriculum towards the matriculation examination. A conceptual framework that defines molecular modelling of proteins by high-school students was developed and served as a theoretical and methodological tool for analysing the findings obtained in this study. This conceptual framework includes four knowledge components: Content knowledge (C) - knowledge about protein structure and function; Procedural knowledge (P1) - knowledge about the use of visual representations in the molecular model; Procedural knowledge (P2) - knowledge about using the software options for molecular modelling of proteins; and Epistemic knowledge (E) - knowledge about molecular models as a scientific tool. Characterization of the tasks included in the learning environment "Bioinformatics in the service of biotechnology" revealed a hierarchy in the use of these knowledge components. The various knowledge components are tightly connected to content knowledge and cannot be separated from it. Examination of students' learning performances while learning using the molecular viewer revealed significant improvement in students' understanding of proteins. Although learning through the tasks and using the molecular viewer can provide an opportunity to acquire authentic scientific knowledge about proteins, the complexity that was identified in students' learning processes, and their limited acquisition of conceptual-scientific knowledge about proteins, point out that learning may have been impaired. Students saw P2 as a major source of interest in learning, although their experience in using the software options was felt as a complex cognitive skill. Future use of the conceptual framework may help bridge the gap between authentic scientific practices and the acquisition of scientific knowledge in high-school.



Professor Anat Yarden is Head of the Department of Science Teaching at the Weizmann Institute of Science, and Head of the Biology Group at this Department. She holds an undergraduate degree in Agricultural Sciences (from the Hebrew University of Jerusalem), a master's degree and a PhD in molecular biology (from the Weizmann Institute of Science), and has carried out postdoctoral training in Genetics (at Stanford University). The primary theme in all of her academic activities has been the attempt to adapt practices employed by scientists to the processes by which students and teachers accumulate and advance their knowledge within the discipline of biology. Towards this end, her group pioneered the adaption of primary scientific literature for the teaching and learning of biology in high schools. Her group had also been a pioneer in adapting currently used bioinformatics tools and databases for the teaching and learning of biology in high schools, thus facilitating authentic scientific research using school computers. Prof. Yarden leads several projects for high-school biology teachers' professional development, including the National Center for High-School Biology Teachers of the Israeli Ministry of Education, Professional Learning Communities of biology teachers, and the biology path in The Rothschild-Weizmann Program for Excellence in Science Education. She is also among the leaders of a Center of Excellence of the Israel Science Foundation aimed to promote argumentation in school classrooms. Prof. Yarden is currently an Associate Editor of the Journal of Research in Science Teaching. She has mentored over 30 graduate students and postdoctoral fellows.

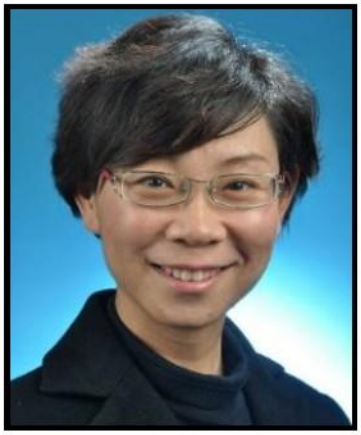
PLENARY LECTURE 7

TEACHING NOW, FACING THE FUTURE

PROF. XIAOYUN LU

Xi'an Jiaotong University
PEOPLE'S REPUBLIC OF CHINA

Education is not only the transmission of knowledge. More importantly, it is to inspire the curiosity of students to understand the world, the science and themselves; to establish their independent learning ability and to develop their critical thought and their practical skill to change our world for the better in the future. Therefore, the most important responsibility of teachers is not just to teach students what has already been known, but to guide them to discover what should be learned and to incorporate the new information into their own knowledge system efficiently. To achieve all these ideals, the student-centered learning model should play its full role both in and out the classroom to evoke the learning initiative of students and facilitate the formation of their proactive self-learning habits. As for teachers, they should be more like coaches, but not preachers. Teachers can take full advantages of the modern information technologies as well as the teaching methods to maximize their influence on the students' learning process. Nowadays, there are more and more high-quality online courses and novel teaching models such as flipped class and blended learning. Besides, some newly developed interconnected teaching tools also appeared recently, which could play a big role during the teaching and learning process. It can provide an efficient and worthwhile feedback to both teachers and students in the flipped class and record huge amount of data to reflect the status of our teaching and learning processes. All these provide us powerful assistants to achieve our teaching goals. Moreover, learning by doing is also an integral part of effective learning processes. The project-based self-learning and self-management pattern is a valuable strategy to develop the learning ability of students. This is totally a student-centered learning-by-doing process and probably the mostly impactful teaching strategy facing for the future.



Dr. Xiaoyun Lu is a professor of biochemistry and molecular biology at Xi'an Jiaotong University, China, who in charge of the teaching of Molecular Biology, Cell biology for undergraduate students and Advanced molecular cell biology for graduate students. She won the top award of Teaching Competition in Xi'an Jiaotong University in the Bilingual group in 2007, was selected as one of the ten advanced individuals in teaching and educating of the whole University in 2011 and won the Wang Kuancheng Award for Educating Talents in Xi'an Jiaotong University in 2015. She also won the top level award in the First CSBMB National Micro-course Teaching Competition and the third level award in National Colleges Micro-course Teaching Competition. In 2019, she was also selected as the FAOBMB education award winner. In 2014, she and her team developed the first Molecular Biology MOOC in China—"Molecular Biology – Principle and technology" which was selected as the National High-Quality Online Open Course by Chinese Ministry of Education. With the help of an intelligent teaching tool, "Rain classroom", she further optimized her flipped class and was selected as a Rain-classroom Intelligent Teaching prominent teacher in 2019. She also participated in organizing and directing practical and innovative training projects for undergraduates. In 2018, she organized the first XJTU-CHINA team to participate the International Genetically Engineered Machine Competition (iGEM) and they won the Gold medal in their first show.