

Accelerating Innovation in 21st Century Biosciences

--- Technical Panel Sessions ---

Technical Panel – AGRICULTURE

Increasing yield, quality, and safety in the world's food supply.

Technical Panel Co-Leaders:

(1) Tamas Torok, Lawrence Berkeley National Laboratory; (2) Steven Britz, USDA

World population continues to increase, while at the same time, thousands of acres of arable land are lost to development each year, and the result is increased pressure on agriculture/aquaculture to provide affordable, safe, and nutritious foods. New and innovative technologies are being developed to improve crop productivity, enhance crop protection, and increase environmental stress tolerance to help meet growing demands on the agricultural/aquaculture industry. Developing and testing these technologies involves sophisticated measurements on complex biological systems (plants, animals, and microorganisms). The “Agriculture” Plenary Lecture and technical panel session will highlight current needs and future opportunities, barriers and impacts of this important sector of biosciences. A report will be developed to identify measurement, standards, and technological barriers to innovation for increasing yield, quality, and safety of the world's food supply.

Technical Panel – ENERGY

Obtaining sustainable energy from biological sources.

Technical Panel Co-Leaders:

(1) Hratch Semerjian, CCR; (2) Terry Purkable, JHU-APL

Recent scientific scenarios and apparent secondary contributions to rising food prices have raised some questions about issues pertaining to sustainability of first generation biofuels produced from food crops (e.g. corn-based ethanol) or those using resources (land and water) necessary for growing food for humans and farm animals. The production of alternative fuels from renewable, non-food, biological feedstocks, however, will remain long-term an important component of any future alternative energy strategy and addressing climate change emissions. Biodiesel produced from oil rich algae or the ecombinant or synthetic biology-based production of next generation biofuels are examples of more sustainable sources of bioenergy that are under development. The “Energy” Plenary Lecture and technical panel session will highlight future opportunities, barriers, and impacts of this important sector of biosciences. A report will be developed to identify potential measurement, standards, and technological barriers to innovation of sustainable production methods for non-food-based biofuels.

Technical Panel – ENVIRONMENT

Understanding our planet through linking molecules to ecosystems

Technical Panel Co-Leaders:

(1) Fred Holland, Director, Hollings Marine Laboratory; (2) Hendrik Emons, Head of Reference Materials Unit, Institute for Reference Materials and Measurements (IRMM) /JRC/EC; (3) Kevin Summers, U.S. EPA

Technological advances in commerce, healthcare, agriculture and energy production in the 21st Century will profoundly affect the condition of the environment in many unanticipated ways. For example, introduction of “new” pollutants (e.g., prescription drugs and metabolites, new generation pesticides, and flame retardants) may impair natural processes and degrade environmental quality. These unintended consequences of environmental alterations have the potential to adversely affect human well-being, including public health, economic sustainability, and the resilience of communities and cultures. It is critical that early warning systems to assess the status and trends of the environment and identify potential threats be established at local, regional, national and global scales before irreparable harm ensues. To mitigate these risks, identification of environmental quality and public health indicators, development of new sensor technologies, measurement methods, and sampling and analysis approaches will be required. The “Environment” Plenary Lecture and technical panel session will explore the potential measurement, standards and technological barriers that must be overcome to establish and implement the required early warning systems. A major focus of these discussions will be identification of the technological advances required to distinguish natural environmental changes from those resulting from anthropogenic activities.

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Technical Panel – MANUFACTURING

Obtaining higher quality products through better bioprocess measurements

Technical Panel Co-Leaders:

(1) Fred Razzaghi, Consultant; (2) William Koch, USP; (3) Larry Mahan, MD DBED

As we enter the 21st century, manufacturing science is touching on nearly every aspect of our lives - from processing starting materials into finished products, to processing waste into energy - and is creating economic value at each step along the way. While technological advances and scientific discoveries are accelerating change and driving innovation in the commercial biomanufacturing sector, the manufacture of many biological products depends on technologies that have remained the same for years. Keeping pace with societal demands for therapeutics, energy and other bio-based goods and services will require innovative approaches that in turn depend on the availability of transformative tools for product characterization and measurement, manufacturing engineering, and knowledge management. The “Manufacturing” Plenary Lecture and technical panel session will focus on identifying critical capabilities for biomanufacturing, and highlight where new or novel metrology methods, standards, and technologies are needed to help blaze the path to 21st century biomanufacturing systems that are risk based, efficient, agile (high throughput), flexible, and focused on quality.

Technical Panel – MEDICINE

Improving health through measurement of complex biological signatures

Technical Panel Co-Leaders:

(1) Judy Britz, Principal at Britz Consulting; (2) Paul J. Utz, Associate Professor of Medicine, Stanford School of Medicine

The future of biology and medicine depends on the development of technologies and research approaches that embrace the high degree of complexity in biological systems. Therapeutic or preventative interventions will be based on "disease signatures" -- unique descriptors that can be definitive markers of health status -- which will be derived from the integration of quantitative and qualitative measurements (biochemical, biophysical and bioelectronic) of hundreds or thousands of biomolecules and/or intermolecular and cellular interactions. Likewise the next generation of health assessment diagnostic tests will be based on multiplex determinations constituting a unique complex signature rather than single markers of biological activities. The shift to signature analysis in diagnostics will help to enable routine health status monitoring that uses each person's own signatures of wellness and disease as the controls against which to detect pathologic changes. This new focus will enable a new comprehensive and integrated approach to wellness that includes prevention of disease, early detection of disease risk and individualized treatment plans for individual patients. The new approach to wellness, in turn, may help control the rising cost of health care, for which spending now consumes nearly one fifth of the U.S. gross national product. The “Medicine” plenary

lecture and technical panel session will highlight current needs and future opportunities, barriers and impacts of this important sector of biosciences. A report will be developed to identifying potential barriers impeding innovation in biomeasurements, clinical trial design and information processing and visualization technologies required to make disease signature analysis translatable into clinical practice.

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Technical Panel – CLOSING THE GAP

Addressing Unrecognized, Overlooked, Underestimated and Ignored Measurement Needs in the Biosciences

Technical Panel Co-Leaders:

(1) Jennie Hunter-Cevera, Office of the President, UMBI; (2) Craig Jackson, Consultant

Science today tends to be driven by what is considered 'hot' in the field, leading scientists to follow down the same path without asking, "Is this path the right path?" Is there an alternative path to choose or investigate? Whether "hot" or not, there are bioscience areas and programs that require the attention of the measurement community, where the lack of measurement technologies and standards lead to the misinterpretation of some biological data and to confusion from a lack of quality control. This one day session will consist of provocative short presentations by industry, academic, and government experts in the fields of medicine, energy, agriculture, environment, and homeland security/forensics who will focus on questions and challenges that may have been unrecognized, overlooked, underestimated or ignored.

Closing the Gap is also a session intended to open discussion of challenges that may not have been addressed during the discussions and presentations of the first day of this program. Questions will be solicited from conference attendees that are directed to identifying needs not covered in the other breakouts. Bioscience is a fast moving field today. However, without measurement technologies and standards to validate our findings, we may be running in circles rather than moving forward.

Attendees with insights and personal experience in areas where measurement technologies and standards are needed are encouraged to submit questions for the panel when they register. Selected questions may be discussed in the brief presentations, others presented as challenges to the members of the audience for brief comment. Topics to be discussed and potential questions for debate include but are not limited to:

Agriculture Viability - What is the "hard evidence" for risk of transgenic plants? What systems are we employing technically in assuring that transgenic plants can become more acceptable? What are the quality assurance measures for animals that are being used to produce pharmaceuticals today? Might immunological concerns make the use of animals too risky to continue? What is the downside to use of antibiotics and steroids in animal production with respect to their own metabolism and cost savings? How can metagenomics play a role in improving crop yield through bio-inoculants? Are certain crops better for addressing the mediation of global climate change than others and how does one measure this over time with respect to soil nutrient depletion?

Antibiotic and Antiviral Drug Resistance – Was this at all influenced by companies using antibiotics as growth stimulants? What will it take to find a new class of antibiotics – or even better yet a really broad class of antibiotics that would even work against "trojan horses" with respect to biothreats? What new technologies and paradigms are needed to predict, detect and manage emerging antibiotic resistant strains that might result in epidemics?

Environmental Bioremediation - How cost effective is bioremediation? Does the benefit of bioremediation differ depending upon the pollutant being remediated? How should resources be allocated for bioremediation when benefits are not definable? Are there biotechnologies or nanotechnologies being developed to deal with "cleaning up" nuclear contamination?

Environmental Bioterrorism Monitoring - Do we now have the right tools to distinguish environmental terrorism from natural phenomena? How sensitive is sensitive enough for finding biothreats released into the environment?

Marine versus Terrestrial Sources of Bioenergy – What are the advantages and disadvantages of tapping these sources? Can we engineer optimal enzyme functions within various organisms that are envisioned as energy producers? What are the anticipated limits that will constrain the use of bioenergy? What advances have been made that improve production rates from various forms of bioenergy to make the cost economical without subsidizing the operation? Are there predictive measurements and or models for prediction of conservation and sustainability issues?

Personalized Medicine - What do we need if we are to realize the benefits of comparing changes within an individual rather than with respect to assumed "healthy" populations? How might personalized medicine balance genomic information with phenotypic information? Are our technologies, analytical methods, and standards adequate for making the long term comparisons implied by personalized medicine and making inferences from changes? Will population comparisons become irrelevant to personalized medicine or will require better definitions of populations and sub-populations?

Stem Cell Therapy – What barriers do we still face in understanding potential tumor formation? How do you stop the cells from proliferating once inserted into the patient? When stem cells become therapeutics, do we have the capability, capacity and know-how required to produce them in the quantities necessary? Will therapeutic stem cells originate from the patient in whom they will be transplanted to a different tissue?

Synthetic Biology - How far have we come and how far do we still have to go? Can engineered pathways in these new life forms really survive and function as 'created' to do so? What are the concerns regarding alterations in the biosphere that should be considered when practicing Synthetic Biology? Or more simply put, could new life forms thrive at the expense of unrecognizably important life forms in the biosphere?