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The American Society of Biochemistry and Molecular Biology is a nonprofit organization representing over 12,000 research scientists. ASBMB is strongly supportive of President Obama and the Office of Science and Technology Policy in pursuing the advancements in biological research to address our national goals and concerns. ASBMB agrees that maintaining America's global leadership status in innovation requires continued support of basic research through strong, sustained federal funding. Basic research has always been the lifeblood of American innovation in science and technology. Countless examples of "game-changing" innovations, such as sequencing the human genome, statin drugs, modern HIV treatments, targeted cancer therapies, organ transplantation/anti-rejection drugs, and the recent introduction of anti-clotting drugs such as dabigatran and eptifibatide have their foundations in basic research.

ASBMB enthusiastically agrees with the administration's efforts to better utilize the power of biological research. In addition, we argue that long-term success requires ongoing emphasis on the innovation pipeline through basic research, even as we develop recent discoveries to meet the "Grand Challenges." In the following section we will present our responses, to questions 1-6, 9, 10, and 12. As ASBMB is primarily composed of basic research scientists, we will address those questions related to our collective expertise. Each response addresses the specific issues within the question with the overarching goal of sustained federal funding for investigator-initiated basic research.

Responses to Questions for the Bioeconomy Blueprint

(1) Identify one or more grand challenges for the bioeconomy in areas such as health, energy, the environment, and agriculture, and suggest concrete steps that would need to be taken by the Federal government, companies, non-profit organizations, foundations and other stakeholders to achieve this goal.

RESPONSE: Research conducted by ASBMB members encompasses all of the areas mentioned; i.e. health, energy, the environment, and agriculture. ASBMB represents significant, non partisan scientific expertise, and we offer ASBMB as a resource for information and advice.

A. Providing for the health care of an aging population: In the United States in the year 2000, nearly one in every eight citizens was 65 years of age or older. By 2030, the U.S. Administration on Aging projects that number to increase to 72.1 million – or one in every five Americans. An aging population will increase the percentage of the U.S. population suffering from Alzheimer's disease, cancers, obesity, diabetes, with the threat of overwhelming the health-care system. New treatments are needed for these afflictions.

   Specific recommendations: A clear track record of successes demonstrates that new treatments will spring from continued support of basic research. ASBMB recommends strong, uninterrupted funding to the National Institutes of Health for investigator-initiated basic research on disease mechanisms related to Alzheimer's disease, cancers, obesity, and diabetes.

B. The obesity epidemic**:** Obesity in the U.S. requires approaches including public health/nutrition education, as well as scientific research

Specific recommendations: Increase public health messages for preventative medicine through better nutrition; provide healthful food to low-income children to replace less-expensive fatty and salty foods that contribute to poor health. Ensure strong, uninterrupted funding to the National Institutes of Health for investigator-initiated basic research leading to a scientific understanding of the cellular and molecular mechanisms of obesity development, which could lead to more effective treatments for Type II diabetes.

C. Diagnostics and preventative medicine: Prevention and early detection of diseases not only increase the probability of successful treatment but can also drastically decrease the overall health-care cost associated with many preventable or treatable conditions.

Specific recommendations: Continue to support interdisciplinary research at the nexus of physics, chemistry, biology, and computational science and engineering. Encourage the development of personalized medicine to include genomic and proteomic database development for individual patients to inform life style decisions and choices throughout the life cycle. Continue to invest in non-invasive methods for detection and treatment of disease, including advanced imaging methodologies and biomarker identification.

D. Agriculture: ASBMB's position is that genetically modified (GM) food will continue to be an important part of a broad strategy to feed an expanding global population. Biases and concerns about GM foods are impeding progress.

Specific recommendations: Partner with organizations like ASBMB to design fact-based public information strategies and educate the U.S. public about the need for further research on the use of GM foods.

E. Energy: ASBMB agrees that the development of clean and sustainable energy is a critical issue for the U.S. Research in biochemistry and molecular biology has led to the development of fuel sources by harnessing solar energy from genetically modified bacteria or by converting plant material through biochemical modifications.

Specific recommendation: Further develop existing programs that focus on alternative-fuel production. Expand the current tax-benefit guidelines for production of renewable biofuels to include newer forms of biodiesels, such as cellulosic and algae-based fuels.

(2) Constrained Federal budgets require a focus on high-impact research and innovation opportunities. With this in mind, what should be the Federal funding priorities in research, technologies and infrastructure to provide the foundation for the bioeconomy?

RESPONSE: ASBMB notes that the instability of federal funding for scientific research has placed our research enterprise and innovation engine at great risk. Other countries such as China and Singapore are investing very heavily in basic science and are successfully recruiting U.S. faculty and research trainees.

ASBMB recognizes and enthusiastically supports developing technologies that already have been shown to have game-changing potential. However, ASBMB argues in the strongest possible terms

that the U.S. must not use the term “high-impact research” to justify supporting and developing only today’s knowledge. We re-emphasize the critical importance of a constant and vigorous supply of new discoveries to feed the innovation pipeline, lest the pipeline dry up to address future challenges. In addition to feeding the pipeline, fundamental research also offers significant economic advantages. Entire industries have been built on unanticipated game-changing discoveries founded on investigator-initiated research, including recombinant DNA technologies and RNA interference.

Specific recommendations:

a) Place a high priority on basic, investigator-initiated research for federal funding. History has shown that many high-impact discoveries grow from asking fundamental questions.
b) Provide a balanced federal investment in translational and clinical research that leverages partnerships with industry and pharmaceutical companies, to apply these basic discoveries to health and technology challenges.
c) Invest in training a highly skilled workforce by funding graduate school science education and by enhancing K-12 programs in science and mathematics.

(3) What are the critical technical challenges that prevent high throughput approaches from accelerating bioeconomy-related research? What specific research priorities could address those challenges? Are there particular goals that the research community and industry could rally behind (e.g., NIH $1,000 genome initiative)?

SEE RESPONSE BELOW

(4) The speed of DNA sequencing has outstripped advances in the ability to extract information from genomes given the large number of genes of unknown function in genomes; as many as 70% of genes in a genome have poorly or unknown functions. All areas of scientific inquiry that utilize genome information could benefit from advances in this area. What new multidisciplinary funding efforts could revolutionize predictions of protein function for genes?

RESPONSE TO QUESTIONS 3&4: Included among the greatest accomplishments of modern biology are the tremendous advances that have been made in applying high throughput technologies for experimental analysis. However these accomplishments present significant challenges because of the vast amounts of data that are generated. New computer algorithms for analyzing large datasets, as well as highly trained individuals who can develop and apply the analysis methods, are urgently needed.

Specific recommendations: Funds should be directed toward the development of more efficient computer algorithms that can analyze, model and simulate large datasets while being usable by laboratory investigators. Programs seeking to unite the work of highly skilled computational researchers with that of biological researchers will be beneficial. ASBMB also recommends increased educational programs that provide students/researchers with a strong understanding of both computational and biological approaches. In addition to computational efforts, funding should also be focused toward large-scale experimental efforts, such as validated and publically available RNAi libraries, mouse knockouts and proteomic probes, that can aid in the prediction of protein functions while computational methods are being optimized.

(5) What are the barriers preventing biological research discoveries from moving from the lab to the commercial markets?

RESPONSE: One of the greatest obstacles facing researchers interested in transitioning their discoveries from the lab to the commercial market is university-mandated technology-transfer policies. Unfortunately this problem is further complicated by the fact that these policies are unique to each university.

> **Specific recommendation:** ASBMB suggests OSTP commission a study across universities to identify the best practices that will grant investigators the greatest ease in commercializing their discoveries.

RESPONSE: Over-regulation is another problem that stunts research in general, preventing biological research discoveries from moving from the lab to commercial markets. Animal-use regulations and conflict-of-interest regulations are important; however, these regulations take on a life of their own as university administrators build their own regulations on top of federal regulations. This problem seems to stem from a fear among universities of penalties for non-adherence but has the result of introducing undue regulatory burdens.

> **Specific recommendation:** Convene a forum for federal representatives, university faculty and administrators to identify best practices for regulatory policies that protect animals and avoid conflicts of interest without duplication and the constant addition of unjustified standards.

(6) What specific changes to the SBIR / STTR programs would help accelerate commercialization of federally-funded bioeconomy-related research?

RESPONSE: ASBMB supports the SBIR/STTR concept; however, these programs must be optimized to ensure the highest quality to meet pressing needs.

> **Specific recommendation:** Review the eligibility criteria for SBIR/STTR grants, which are currently overly restrictive and exclude many investigators at universities or research institutions. ASBMB recommends that the quality of the SBIR/STTR programs would be enhanced if the scientific community played a greater role in identifying projects that receive consideration for funding.

(9) What modifications should be made to professional training programs to better prepare scientists and engineers for private-sector bioeconomy jobs?

RESPONSE: The preparation of scientists and engineers for private-sector bioeconomy jobs must begin at a stage that far precedes professional training programs. Unlike in Asia and other parts of the world, accomplishments in mathematics, science, and engineering in U.S. K-12 (and some university) students are often viewed with significantly lower regard than accomplishments in athletics, for example. The national ethos needs re-aligning so that young students see that careers in the sciences are valued and valuable.

Graduate students are the primary workforce of the academic research enterprise and are a vital component for its progression. While many graduate students remain in laboratory-based research careers, increasing numbers of students are moving to careers in private industry, education and even science-related, non laboratory professions. Part of the efflux of graduate students from research professions is a result of the funding insecurity faced by many investigators. A stable

funding environment would make research professions more attractive and help retain graduate students in the research enterprise.

> **Specific recommendation:** Maintain and strengthen the pipeline of scientists and engineers by funding graduate school training programs. Convene groups of university faculty and industry leaders to discuss respective needs for preparing university academicians and private sector scientists. Recommendations could be used to consider enhancements to Ph.D. curricula or the further development of degree programs that combine biological research with other skills sets, such as business, law, education, and public policy.

(10) What roles should community colleges play in training future bioeconomy scientists and engineers?

RESPONSE: While the research enterprise is dependent on a skilled and knowledgeable workforce, the American bioeconomy would greatly benefit from a scientifically literate general population. Community colleges are the first and often only exposure many Americans have to higher education and should be viewed as a critical component to increasing the scientific literacy of our society. Community colleges also serve as an opportunity for high school graduates to reinforce their math and science skills, ensuring they are prepared for the rigors of a university education. ASBMB acknowledges that community college professors must have a high level of scientific knowledge in order to adequately instruct their students on the importance and relevance of science.

> **Specific recommendation:** ASBMB supports federal incentives to attract highly trained individuals to teach at community colleges to expose students to the highest level of scientific information. Community colleges are well positioned to offer degree programs in laboratory management to supplement the more highly skilled Ph.D.-level scientific workforce. ASBMB encourages the federal government to convene discussions among industry/private sector scientists, university faculty, and community college faculty to generate recommendations relevant to developing a career track for laboratory managers that would represent a stable workforce to support the bioeconomy.

(12) What role might government, industry, and academia play in encouraging successful entrepreneurship by faculty, graduate students and postdocs?

> **Specific recommendation:** Rapid progress can be achieved by learning from, and applying successful existing models, such as the Massachusetts Institute of Technology, where many faculty are entrepreneurs, where the university administration supports faculty interests in entrepreneurship, and where a local bioeconomy ecosystem has developed around the university. The federal government should develop programs permitting academia and industry to work together more closely, meaning that intellectual property issues must be resolved so that both industry and academia are rewarded.

> **Specific recommendation:** To encourage entrepreneurship, ASBMB is supportive of undergraduate and graduate programs that combine research experience and business training and believes the federal government should invest in programs that introduce concepts in entrepreneurship without diluting the intensity and focus of the scientific training that forms the core of U.S. strengths in science and engineering.