Welcoming remarks

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Plenary Session

Vision & Change in Undergraduate Biology Education

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I am pleased to welcome you to this very important meeting that will help to chart the future course of undergraduate biology education in this country.

I commend the American Association for the Advancement of Science for convening the conference and am pleased to say that the National Science Foundation strongly supports its efforts. I also welcome the participation of our colleagues from the Howard Hughes Medical Institute and the National Institutes of Health.

The real work of transforming undergraduate biology education must, of course, fall to the educators and biologists themselves, but there is

no doubt that NSF, AAAS, HHMI, NIH and others can act as catalysts to help spur change.

I can safely say that the excitement and dedication of these agencies and groups to creating this new vision for teaching and learning is shared by practitioners in the field. When the invitations to this meeting were sent out, several hundred of you confirmed your attendance almost immediately. Your rapid response and passionate interest in this endeavor typifies the devotion you have to your discipline.

As you rethink the ways in which future biologists come to learn their discipline and other students obtain an appreciation of science, you may want to reflect on the techniques of Louis Agassiz, the great 19th century natural historian.

According to the distinguished American history writer David McCullough, Agassiz would present his future scientists with a fish and, responding to their puzzled questions about what he expected them to do with it, said simply: “Look at your fish.”

Agassiz would then leave, often for hours, sometimes for a full day. Leaving his bewildered students to look at their fish until, long past the point of frustration, they eventually would actually begin to see their by-then revoltingly familiar specimen in an entirely new light, to note new features and to really understand the totality of what they thought they had been staring at for far too long.

When he returned, McCullough reports, they would point out the features they previously had missed to the delighted Agassiz, who would then exhort them to move on in their task. They were, he told, them to look at their fish…again.

To those with the patience and the passion, it was an experience they never forgot: a lesson in persistence and in the importance of adjusting perceptions to discover the new and exciting in the familiar.

That, I hope, is a very good metaphor for what you are gathered here to accomplish.

To be sure, there are even now pioneers in the field of biology education who are embracing new methods to excite their students by observing that the *status quo* is not achieving those goals. By doing so, they individually breathe new life into their discipline. But we must sadly concede that this is not the norm.

This conference is the culmination of a two-year-long series of conversations among educators to create a shared vision for the future of undergrad biology education. The next step is to coax and convince those in the field to adopt these ideals.

NSF fully supports what you are about. Let me just give you a few of the reasons why.

- Integrating research and education is a keystone of NSF's strategic plan. Just as we are transforming the way we do research, we must simultaneously transform the way we train the nation's next generation of researchers and citizens.

Introducing techniques like inquiry-based learning in the classroom will give students the ability to continue making their own discoveries in a lifetime of learning.

In short, just as Agassiz did, we want students to learn the same way that researchers learn: far more through observation and individual discovery of key concepts, far less through rote.

Investing in a robust undergraduate education system will not only enable us to nurture the intellectual capital of our future workforce, it will equip all citizens, not just future scientists, to, in the words of the letter of welcome to this conference, "to make informed decisions, and interpret the consequences of decisions made by others."

One of our most important tasks is to articulate a detailed plan to increase the participation of under-represented groups in science and engineering. This plan must be inclusive of all institutions and all regions of the nation, not just an elite few.

- The timing for this conference is indeed opportune.

Societal and political interests are igniting a “new Age of Biology and the convergence of biology with the physical sciences.” There is innovation in a host of research areas including metagenomics, climate change, and clean energy. These multifaceted fields require pioneering biologists to open wide new frontiers by reaching beyond the edges of their disciplines.

At the very same time, there is a very wide and significant gap between the worldview of scientists and the general public.

A poll by Pew Research Center for the People & the Press and the AAAS, reports in the July 7 *New York Times,* that almost a third of ordinary Americans say human beings have existed in their current form since the beginning of time, a view held by only two percent of the scientists.

How are we to open the eyes of this majority of people to the wonders of science if we do not change our ways?

- That said, it is indeed a wonderful time to try.

  Each week at NSF we hear news of exciting new discoveries with far-reaching implications, such as the work going on Ed Delong's lab at MIT.

  There, with NSF funding, researchers probe microbial communities to discover and catalogue new groups of "small RNAs", those non-coding snippets of nucleic acid that function directly as regulatory molecules.

  Previously, our knowledge of the vast RNA toolkit used by bacterial communities was limited to those strains that could be cultured in the lab. But techniques such as those used by the Delong group allow biologists to sequence collections of nucleic acids from environmental samples, thus gaining access to genetic material from a much wider sample of organisms that have never been grown in a lab.

The use of molecular toolkits to answer questions about metabolic processes and ecosystem functions in various parts of the globe illustrates that biological research is becoming more integrative.

NSF invests in all fields of science and engineering, from the social sciences, to math, to cyberinfrastructure. The agency is uniquely positioned to inspire and foster cross-cutting research.

Building on a $299 million investment in the Climate Change Science Program, NSF will invest $198 million in interdisciplinary climate research.

This work will address ecosystem vulnerability, the carbon cycle, ocean acidification, abrupt climate change, dynamics of water in the environment, and weather extremes.

The results of this research will strengthen the scientific basis for designing effective adaptation and mitigation strategies.

- We know that the non-scientific public is deeply interested in the subject of the changing climate, yet even here we are failing in our efforts to reach the broader public with scientific truths.

  The same Pew poll I mentioned earlier found that only about half of the public agrees that people are responsible for some element of climate change, and 11 percent does not believe there is any climate warming at all.

  The good news is that in 2010, NSF will launch a Climate Change Education Program to broaden climate learning, from K-12 to the graduate level, and to increase the public's understanding of climate change and its impacts.

  But I very much fear that unless we change the “how” about teaching this intrinsically interesting subject, we may not be successful in budging those poll numbers.

  As a community, you have set yourself a bold challenge. I wish you well as you tackle it. NSF is behind you all the way.

Now, I suggest that as you get ready for the day's activities tomorrow, you brace for a long, but rewarding day of "looking at your fish."