# CREATING AMERICAN SCIENTISTS: WHAT SHOULD BE DONE—IN AND OUT OF THE SCHOOLS?

**Science Symposium Report**
**Distributed by Fenway High School to Symposium Participants**
**November 2006**

On Wednesday, November 2, 2005, Fenway High School, the Boston Museum of Science and Dana-Farber Cancer Institute co-sponsored a symposium that brought together educators, students, scientists, business people and policy makers.

The objectives of the symposium were to:

- Share diverse views on why too few American students are becoming scientists today.
- Identify the dilemmas in science education and the consequences of not resolving them.
- Generate a report summarizing key points that will be used to inform discussion about the policy-making and practices of science education.

## CONTEXT

### Capturing Data

The attached spreadsheet is the central focus of this report. The spreadsheet shows both the range of participants' views on how best to create American scientists and the collective weight of some views over others.

About 120 people attended the symposium. They were mixed in table groups of eight to ten people. To help focus discussion, all tables were asked to address this question:

**If you had $20 million dollars to improve science education, how would you spend it?**

There was a facilitator at all but one table and a recorder at every table. The recorders used laptop computers to capture verbatim what participants said. The remarks of 85 people were recorded, with their names. After the symposium, the remarks were grouped by the following seven constituencies:

(20) K-12 teachers
(17) Higher education
(15) Science/business/professionals in the field
(15) Program or policy developers
(9) K-12 leaders/administrators
(6) Students
(3) Education assessment specialists

### Identifying Spending Categories

Although the words used by participants varied, their answers to the spending question could be sorted into fairly clear categories, e.g., "Equipment and materials for inquiry-based projects" or "Class size (adult to student ratio)." In order to represent the full spectrum of priorities, even categories mentioned by just one participant are included on the spreadsheet, bringing the total number of categories to 25.

Note: this should not be taken to mean that all possible ideas about spending are represented in this report, nor that all 120 participants' ideas are represented. Some views may have been lost in the flow of the table discussions or—given that only 85 people were identified in the recorders' notes—not expressed.

### Spreadsheet Layout

There are two sections on the spreadsheet:

WHERE TO PUT THE $20 MIL – BY TARGET SPENDING
WHERE TO PUT THE $20 MIL – BY CONSTITUENCIES

The first, *By Target Spending*, lists each category once, and groups it with others in the same target spending area, such as "In the Schools." The data in the columns shows:

Col A: list of categories, sorted by target spending area

Col B: the total number of participants (85) whose remarks were recorded during table discussions

Col C: the number of participants who said they would put some or all of the $20million into that category

Col D: the percentage of participants who said they would put some or all of the $20million into that category. Since participants often advocated for more than one spending category, percentages may add up to more than 100%.

Col E: the number of constituencies represented.

The data in the *By Target Spending* section is drawn from the *By Constituencies* section. Columns A – D are the same, but the spending categories are organized by constituencies rather than by target spending areas. Spending categories often repeat from one constituency to another. Where there is repetition, Column E on the *By Target Spending* section reflects it.

## READING THE DATA

### Caveat

This report was created and distributed by Fenway High School, with the approval of our symposium partners, the Boston Museum of Science and Dana-Farber Cancer Institute. We are

not educational researchers and do not claim any statistical or scientific authority for this report. We know there are many ways in which the data presented here could be skewed, by the table discussion format, by the variance in recorder and facilitator skills, by the categories we have created, by the individual personalities of participants, by the temperament of the day on which the symposium was held.

With the caveat that this report is meant to be suggestive rather than conclusive, and with the hope that it will stimulate policy makers to seek more input on the central issue of creating American scientists, we would like to draw attention to what we found striking in the data and share a few comments about it.

## Highlights

We have highlighted eight of the 25 spending categories on the Target Spending section because they were seen as priorities by over 10% of participants. (The category, "More instruction and activities in K-8", might also have been a priority if there had been more K-8 educators at the symposium.)

**Of those eight top categories, five were in the Schools target area**:

39% (6 constituencies): Teacher development & support in using inquiry-based approach

26% (6 constituencies): Equipment & materials for inquiry-based projects

22% (5 constituencies): Teacher release time for lesson planning, collaboration

16% (3 constituencies): Class size (adult to student ratio)

13% (6 constituencies):Teacher/mentor passion for subject

Comment: these five categories are closely related; it is hard to see how one could be accomplished without the others. Teachers can't do inquiry-based projects without the necessary equipment, materials and training. Inquiry-based projects require teachers to do more complex planning and curriculum development than textbook-based lessons, which means teachers need extra release time and the support that comes from collaboration with other teachers and outside experts. Inquiry-based projects are done in small student groups so that every student can have a direct, hands-on experience while also working in a team, as practicing scientists do. The inquiry groups need an adult close at hand who can provide guidance and respond to questions quickly; hence, the requirement for a high adult to student ratio in the science classroom or lab. Finally, teachers who lack passion for their subject are not apt to invest the time and energy needed for inquiry-based projects. On the other hand, inquiry-based projects tend to generate and support a passion for science, in both teachers and students.

Note: given the interrelations among these five spending categories, they might be considered a single category with different facets. Taken together, the percentage of participant support for spending on inquiry-based science education was very high.

Comment: "Teacher education – content knowledge in specific science areas" only received 4% mention from 3 constituencies. It is hard to interpret the low percentage here, especially since the category could include both single discipline and multi-discipline approaches to teaching science. For example, people who think that chemistry teachers need to know more chemistry might approve this category, along with people who think teachers should be able to integrate chemistry with biology and physics in a holistic curriculum. One possibility is that this type of professional development was not seen as important as teaching teachers to do inquiry-based projects. Another is that participants didn't think to isolate it as a separate priority.

**Two of the eight top categories were in the Community target area**:

53% (all 7 constituencies): Internships, mentoring & pipeline programs (for teachers and students)

16% (4 constituencies): Increase teacher pay, recruitment efforts

Comment: the disparity in the numbers between these two categories should provoke further investigation by community funders and policy makers. Although teacher pay and recruitment was seen as an important factor by over ten per cent of symposium participants, almost three times as many participants thought that placing and mentoring teachers and students in the "real world" of science was more critical to the creation of American scientists. The fact that almost a quarter of the recorded table remarks were made by teacher themselves adds interest to these numbers.

Comment: similarly, two other categories involving financial incentives received only slight mention. "Pay students for activities outside the classroom" got 2%. "Financial incentive: tax credits for community service toward science education" got 1%.

**One of the top categories was in the Culture target area:**

33% (all 7 constituencies): Media messages & public education re: science careers for youth.

Comment: the high percentage here and the cross-constituency agreement suggests that organizations in a position to influence American culture, e.g., national and state governments, and large organizational funders, should give serious consideration to media initiatives and/or broad-based programs aimed at changing the public view about science.

## THE ACCOUNTABILITY ISSUE

It is difficult to report with any sense of accuracy on the discussions about accountability/ assessment/testing that took place at the symposium. Table recorders captured two somewhat different priorities:

6% (3 constituencies): Accountability – need for clear, relevant assessments

4% (2 constituencies): Accountability – need for high stakes tests

On the assumption that the first stems from teachers' needs for instruments that will help them diagnose student understanding and performance in the classroom, we placed it in the Schools area of Target Spending. We placed the second in the State subsection, on the assumption that it stems from the public's need to know that students are meeting high graduation standards and that teachers are getting them there.

The data suggests that few participants consider accountability measures (of either kind) to be high priorities in improving science education, at least not in comparison to the top eight categories named above. However, during the report-out time after the table discussions, a heated debate ensued among the general company about the purpose and type of the science assessments currently being developed at the Massachusetts state level. Clearly, it is a key topic, as well as a thorny dilemma currently facing policy makers.

Comment: given the low level of priority put on high stakes testing in most table discussions, and given the great impact that high-stakes testing in science could have on students' desires and abilities to enter scientific careers, this topic warrants more thorough investigation before significant resources are assigned to the development and implementation of such tests.

## MUSEUM COLLABORATION

One category that did not emerge from table discussions deserves mention in this report. That category is "museum collaboration," and four people who would have considered this a priority for spending were engaged either as table recorders or, in the case of Lynn Baum, Manager of Youth Programs for the Boston Museum of Science, as symposium moderator. Fenway's long partnership with the Museum has shown that co-developing curriculum and moving the science classroom to the premises of a science museum can have a significant impact on student engagement and learning in the sciences.

## PANELIST REMARKS

There were four highly distinguished panelists at the symposium. Each was asked to summarize his/her work in science, describe how s/he was drawn into it, identify the major challenges s/he faces, and give an answer to the central question of the symposium: *Creating American Scientists: what should be done—in and out of the schools?*

It is a shame to skip over the information, stories, humor, insights, personal experience and plain talk that each panelist delivered in five short minutes. For brevity's sake, however, we will limit this report to a summary of the answers they gave to the central question.

### Edward J. Benz, Jr. MD, President & CEO, Dana-Farber Cancer Institute

Where the "great scientists" will be coming from is not the central issue. I'm more concerned about where the scientifically prepared people—working in science and health but also providing scientific expertise and perspective in other sectors of our economy—where will they come from? In this era when science is requiring more and more team work and multidisciplinary approaches… Science is moving from the laboratory, the high ivory tower in the sky, to project management. We must train not only the lead scientists but the supporting staff.

My policy recommendation: it's about the teachers. Whatever incentives you put forth—externships, after school programs, etc.—whatever extra funds must be spent, put in the hands of teachers, and focus on helping them develop the opportunity and culture among students that it's great to be good in science… Working scientists, students, and teachers together can change this, whatever it costs, we'll get the biggest bang for the buck.

### Daren T. Wells, Department Chair, Timilty Middle School, U.S. Presidential Award 2004: Science and Mathematics

ONE on ONE—most people become something they want to be when they know somebody. In Boston we have more research facilities within less than five miles… Mandate that everybody who applies for a job has to give a certain amount of their time to a K-12 student throughout the school system. Let the students know they can be who you are. Don't expect the teachers to do it all. Business must invest in the community.

### Joan Y. Reede, MD, MPS, MS, Dean for Diversity and Community Partnership, Harvard Medical School

Speaking from the perspective of someone involved in medical education, use the issue of health disparities in our country to highlight the need for workforce diversity in science… No way to address the diversity in our professional workforce if we don't have children who can get out of high school. The pipeline is critical to our success… There needs to be continuity. Two week exposure is not enough. Programs have to involve collaboration and partnership. Some of the things we do at Harvard Medical School: after school programs, summer camps, teacher prep programs, curriculum development… Part of what we need and have in this room are leaders, leaders who can see the big picture and can look beyond their personal role to commonalities of purpose…

### Edward M. Augustus, Jr., Massachusetts State Senator, Vice Chair of the Joint Education Committee

Important to create a dialogue about science so that it can be funded by politicians…Want to do all the cutting edge teaching and learning, but when the roof leaks, that's the immediate problem. There are so many of those challenges that it is incumbent on us to put our money where our mouth is. We need to hear from people who care about increasing resources… The bad news is that we have a governor who says now is the time to do a tax rollback. About $80 would go to the average taxpayer and it would lock in the educational deficit… Need to hear from folks like you that it's the right thing to do to use new revenues to upgrade math and science facilities, and revamp school funding construction with the sales tax. It's not enough to just keep pace with other schools. Kids need hands-on opportunities now, they can't wait…