Science Policy: The Candidates' Response

Question 1

How important do you think basic science is for our country in general, or specifically, in areas such as improving health, preventing pollution of the environment, and the creation of jobs? Do you think appropriations for science should be increased, decreased, or kept level?

I am convinced that support of basic science is one of the soundest investments that we as a nation can make in our future.

The strength and vitality of basic science in America will do much to determine the future of our country. Continuing preeminence in basic science translates directly into economic growth, the creation of jobs, a healthier population, and a cleaner environment. It is critical that these investments be sustained.

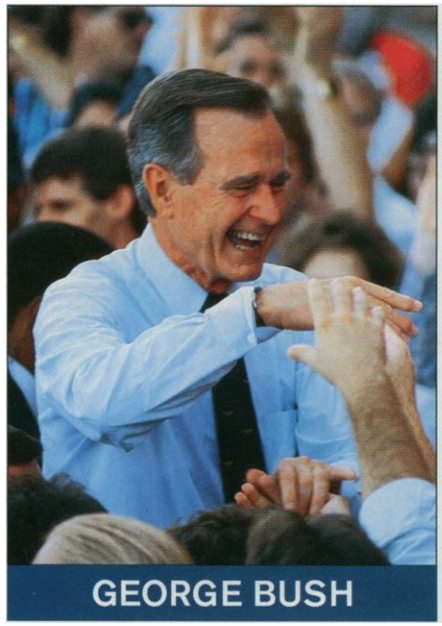
A strong basic science program has been a pillar of my Administration's policy. If the Congress responds to my FY 1993 budget requests, support of basic science will have increased by 35% during my Administration, and this has occurred during a period in which we have had to restrain domestic discretionary spending. Major presidential initiatives have been launched—in biotechnology, materials science, advanced manufacturing, high-performance computing and communications, and mathematics and science education.

I have supported both basic and applied R&D. My budget includes an increase of 13% for basic research. It also includes increases of 23% for high-performance computing, 11% for materials, 8% for biotechnology, and 27% for advanced manufacturing.

A broader and stronger basic science foundation has been and is being built. It is more closely linked than ever before with translation into practical applications such as pollution prevention and improving health. Impressive as the progress has been, the effects of these investments have yet to be fully appreciated. Rather, we look ahead to the latter part of this decade and into the next century to appreciate the magnitude of their importance.

Question 2

What is your position on "big science" versus "little science"? Specifically, would you increase or decrease the appropriations for each of the following: the space station, the supercollider, the genome project, the National Institutes of Health, the National Science Foundation?



LARRY DOWNING/SYGMA

I view federal support for research as an investment in our country's future. As with all investments, the important question is not whether the investments are "big" or "small" but whether they are sound. That is the criterion my Administration applies to proposed expenditures on science, and that has convinced me to propose significant increases for research in my annual budget requests to Congress.

In preparing the budget for submission to the Congress in each fiscal year, we have given special attention to the need to balance supporting the current work of today's scientists and engineers with investments in the major facilities and programs that will take these same individuals to the frontiers of their fields—and help define those frontiers—5 to 10 years into the future.

Those in the scientific community who believe that money cut from "big science" will be devoted to "little science" have been proven to be wrong. In past years, Congress has used funds cut from my science budgets to fund pork-barrel water projects and subsidies for public housing authorities. So the real debate is not between "big science" and "little science"—it is between investment in the future and spending on current consumption.

I have proposed to increase the appropriations for each of the activities you have mentioned, and I have done everything in my power to increase them. Specifically, in my budget for FY 1993, space station is up by 13%, Superconducting Super Collider is up by 34%, NIH is up by 5%, and NSF is up by 18%. Unfortunately, the Congress has consistently short-funded those important projects and agencies and has appropriated significantly lower amounts than I have requested. For example, I recommended that the NSF budget be increased by 18% in FY 1993. While Congress still has not passed an appropriations bill at this late date (12 September), our best information is that Congress will appropriate little or no increase and thus will force the NSF to cut research programs.

Question 3

There has been a shift in criteria for funding basic research at NSF and NIH toward emphasis on the possibility of creating U.S. jobs—that is, national competitiveness. Would you favor that as a criterion for research funds? How would you implement criteria that would set that objective?

Our support of basic research in these and other agencies is an investment in our future, but by its very nature it is impossible to predict where, when, or to whom the benefits will flow.

Nevertheless, we can be sure that these benefits will be substantial. Professor Edwin Mansfield of the University of Pennsylvania has found that the social rate of return from such investments in academic research can very conservatively be estimated at 28%.

To take just two examples of how basic research can be translated into economic returns, NSF support of fundamental condensed matter research has had a major impact on both microelectronics and materials science, while NIH support of fundamental biology has provided much of the foundation for the biotechnology industry. Both of these areas have been and will be major producers of U.S. jobs.

The primary criteria for funding basic research have been, and should remain, the excellence of the proposal and the track record of the proposer. While no clear division is possible between basic and applied research, thematic or targeted research is funded with the intent of developing new materials, processes, and products that will contribute directly to economic competitiveness and

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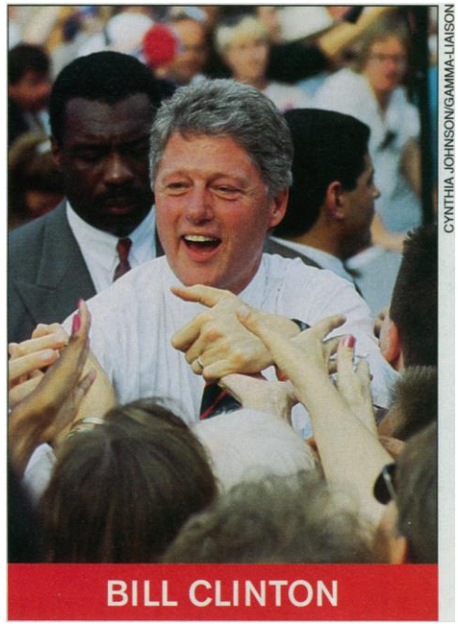
George Bush is President of the United States and the Republican candidate for president.

The next President of the United States will decide many issues that make headlines. His decisions on national science policies will be much less publicized but may have a profound effect on citizens' lives. Because these policies involve such matters as seeking cures for diseases, global competitiveness, and the ecosystem, they also affect citizens of all countries. At the invitation of **Science**, *President George Bush and Governor Bill Clinton have described their positions on a number of science policy issues. Each candidate was asked to limit his responses to an average of 500 words or less. Their willingness to participate in this Policy Forum indicates their recognition of the importance of science in relation to the general welfare.* —DANIEL E. KOSHLAND, JR.



Question 1

How important do you think basic science is for our country in general, or specifically, in areas such as improving health, preventing pollution of the environment, and the creation of jobs? Do you think appropriations for science should be increased, decreased, or kept level?

Our stress on basic scientific research has been, and continues to be, important for the United States. Our science policy since the end of World War II has paid tremendous dividends for the nation. It has made the United States a world leader in science; has made America's university education and research system the best in the world; has allowed us to supply ourselves and other nations with skilled scientists and engineers; and has made it possible to provide technology to academia, industry, and the government on a scale that no single company or laboratory could have accomplished alone.

Today, the federal government provides the bulk of all basic research funding for U.S. researchers. I have called for increases in funding for both AIDS-specific and general biomedical research and have pledged to reinvest every dollar cut from defense R&D into civilian research and generic technology development.

Question 2

What is your position on "big science" versus "little science"? Specifically, would you increase or decrease the appropriations for each of the following: the space station, the supercollider, the genome project, the National Institutes of Health, the National Science Foundation?

Both kinds of research are vital; I do not accept the view that one must be sacrificed in order to sustain the other. A continued high level of support for research performed by individual researchers and small teams will be a priority—this type of research is the source of most new discoveries and innovations. Some types of research, however, can only be done in large facilities or by large groups of researchers and technicians. I support the space station, the supercollider, and research into shortcuts to map the human genome, but under current economic conditions, it only makes sense for nations to share the costs of the very large and costly science projects which ultimately benefit all people and all nations. I would make sure that appropriations for the National Institutes of Health and the National Science Foundation at least keep pace with inflation and be increased further as soon as budgetary conditions permit.

Question 3

There has been a shift in criteria for funding basic research at NSF and NIH toward emphasis on the possibility of creating U.S. jobs—that is, national competitiveness. Would you favor that as a criterion for research funds? How would you implement criteria that would set that objective?

The National Science Foundation and the National Institutes of Health are internationally renowned and emulated for their high-quality support of the best basic research in the world. This support for basic research must be sustained and strengthened.

The linkages between basic research and technology development are becoming increasingly prevalent. The absence of a coherent technology policy is one of the key reasons why America is trailing some of its major competitors in translating its strength in basic research into commercial success. My technology policy picks up where our science policy leaves off. Under a Clinton-Gore Administration, the criteria for NSF and NIH funding of research—excellence and merit—will not change. More attention will be paid to making the results of that research, where possible, relevant and quickly available to the development of technologies by industry.

Question 4

Would you favor giving EPA a research capability on environmental matters similar to NIH's research capabilities on medical matters?

We cannot protect the environment or public health in a cost-effective way if EPA's regulations are not based upon high-quality science. William Reilly, the present EPA administrator, has made a concerted effort to put EPA's environmental protection strategy on a firm scientific foundation, but he has not received adequate support from the present Administration. There is a clear need for expanding environmental research programs, but we cannot expect a single agency to be responsible for addressing every environmental problem. Consider just one environmental problem: global warming. More than ten agencies, including NASA, the National Oceanic and Atmospheric Administration, and the National Science Foundation, contribute to the U.S. Global Change Research Program because no single agency could collect and analyze the variety of data needed to understand the problem. In addition, almost as many agencies are doing research on ways to address the problem. We can, however, do a much better job of ensuring that other agencies work more closely with EPA.

Question 5

What are your feelings about the biodiversity treaty of the Rio summit? What, in general, is your attitude toward international patent rights?

Today, species are becoming extinct at more than a thousand times the historic rate and the pace is accelerating. Entire ecosystems are disappearing. I believe that we missed a great opportunity at the Rio Earth Summit last June to exert international leadership on this issue and a host of other global environmental issues. Rather than opposing the efforts made there by many other countries, we should have helped shape, and then signed, the Bio-Diversity, Earth Charter, Agenda 21, the Forest Principles, and Climate Change Conventions—and, in so doing, conveyed our commitment to a world in which each

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Bill Clinton is governor of Arkansas and the Democratic candidate for president.

national security and to improving the quality of American life.

The development of generic, precompetitive technologies falls into this latter category of research; we have emphasized our willingness to work with the private sector in consortia, in Cooperative Research and Developmental Agreements (CRADAs), and in three-way partnerships involving industry, academia, and federal and state governments. Involvement of the private sector from conception of the research through its completion is an essential element in effectively prioritizing and implementing this research.

Question 4

Would you favor giving EPA a research capability on environmental matters similar to NIH's research capabilities on medical matters?

I am completely convinced that environmental policies and regulations must be based on sound science and on sound economics. I have strongly supported EPA Administrator Reilly's efforts to build a much stronger scientific community within EPA. We have increased EPA's research budget by 33% since 1989. At the same time, I have requested that the National Academy of Sciences provide me with its recommendations concerning the optimal structure and scope of the scientific research activity required to support rational environmental policies at all levels. Among other approaches, the NAS committee is considering the establishment of a National Institute for the Environment, modeled on NIH. This NAS study is still in progress, and I await its completion with great interest; pending its completion I would not wish to comment on the appropriateness of any particular structure for environmental science.

In considering this issue, there are several principles I would affirm that need to guide our thinking. The first and most important principle is the preeminent need for quality research. Second-class research is truly of no use at all. In fact, particularly with environmental matters, poor-quality research can cause great harm and result in unnecessary expenditures.

So my first principle would be that our focus should be as much or more on the quality of research being done as on the quantity. In particular we should strive to apply peer review to as much environmental research as possible. Peer review has served the United States extremely well in maintaining a clear focus on excellence.

The second principle is the need to maintain diversity in our research system for environmental R&D. A unique aspect of U.S. science and technology is that our science and technology program is built largely from the bottom up rather than the top down. In most countries, a science and technology budget is established by the appropriate governmental body that is then divided among different programs. In the United States, the situation is more pluralistic, driven by scientists and their research needs instead of by bureaucratic or political priorities.

In such a system coordination becomes a considerable challenge, which brings me to my third general principle. It is essential in interdisciplinary areas such as the environment to coordinate and integrate agency programs to produce coherent national programs rather than collections of heterogeneous agency programs.

We have been quite successful in achieving such coordination through a number of programs, including the newly revitalized Federal Coordinating Council for Science, Engineering, and Technology. FCCSET brings together representatives from the various federal agencies that are involved with science and technology to work out ways to integrate interagency efforts most effectively and to ensure that the maximum science and technology results are obtained at whatever investment level congressional action makes possible. Another example is the Strategic Environmental Research and Development Program (SERDP), which identifies research and technologies developed by the departments of Defense and Energy that would have useful applications in the environmental field. In sum, it is not the institutional location or structure of research that matters, but whether the research meets the three principles of quality, diversity, and integration.

I have been very disappointed with Congress's piecemeal approach to my multiagency research and education initiatives (that is, math and science education, materials, biotechnology, high-performance computing, and global change). We have tried to ensure that these multi-agency efforts are responsive to their objectives and are properly coordinated through both the development and review process. The uncoordinated review of these programs by the House and Senate, however, has significantly impeded the progress of these efforts.

Question 5

What are your feelings about the biodiversity treaty of the Rio summit? What, in general, is your attitude toward international patent rights?

I would like to reiterate a point that I made repeatedly in Rio. The United States' decision not to sign the Convention on Biological Diversity in no way reflects a weakening of this Administration's commitment to the conservation of biological diversity. To the contrary, I stated in Rio that U.S. actions would exceed the conservation requirements of the treaty, and we will continue to take steps domestically and internationally to conserve this valuable resource. To this end, the United States proposed, at the United Nations Conference on Environment and Development, an international effort to improve the collection and management of information on biodiversity. The proposal will permit immediate action on this issue and need not await the entry into force of the Convention on Biological Diversity. We also are committed to domestic programs aimed at protecting biological diversity, including establishing a domestic biodiversity information center. We will continue to pursue bilateral and multilateral efforts to encourage such activities abroad.

The United States is strongly committed to the conservation of biological diversity, both through protection of endangered and threatened species and through preventive measures to protect habitats and ecosystems in order to limit the number of species that become threatened or endangered. Indeed, we have the world's strongest laws to protect biodiversity.

Originally, the United States envisaged a Convention limited to the conservation of biological diversity. Unfortunately, some countries insisted that the Convention address additional issues that the United States considered inappropriate, or beyond the scope of, such an agreement. These included the regulation of the development and use of biotechnology products, concessional terms for sharing benefits derived from biological resources, and the creation of a special financing mechanism under the Convention. Ironically, the way the Convention ultimately treated some of these issues will likely result in less, not greater, protection of biodiversity.

The Convention would remove from donor nations control over both the amount of their contributions and how they would be used; would regulate an industry—biotechnology—that has enormous potential to improve the human condition and advance conservation; and would interfere with the basis of our free trade economy—the system of patents and intellectual property rights.

I believe that international patent and other intellectual property rights protections are essential to a fair international marketplace and to the protection of American competitiveness in that market. I have insisted that all our agreements include strong protection. In the long run such actions benefit our collaborators and trading partners as much as ourselves.

Question 6

Do you expect to make changes in the White House science policy apparatus? In particu-

lar, will your science adviser remain at the level of Assistant to the President? Will your science adviser be involved in the selection of officials in top science posts in your Administration?

Under my Administration, science has had the highest priority. I made the science adviser an Assistant to the President and revitalized the FCCSET. I do not anticipate any significant changes in the White House science policy apparatus. My science adviser will continue to hold the rank of Assistant to the President for Science and Technology and will serve as Director of the Office of Science and Technology Policy in the Executive Office of the President. Participating in the selection of top scientists for government service will be one of the adviser's very important roles in the early days of my second term.

During my current term, the Office of Science and Technology has been greatly strengthened and, through a revitalized FCCSET, has been responsible for unprecedented cooperation among the federal agencies and integration of their programs in a number of critically important areas. The President's Council of Advisors on Science and Technology has made available to me and to my senior White House staff the advice and counsel of an outstanding group of Americans with extensive experience and deep wisdom.

Question 7

What specific steps will you take to improve science education in grades K through 12? For example, should science requirements be increased in high school?

In addition to developing objective performance standards for what students should be expected to know as they complete grades 4, 8, and 12, it is essential that our teachers be given access to additional training in their fields of expertise. During the coming FY 1993, 45,000 elementary school mathematics and science teachers are expected to receive such training. During each remaining year of this decade, we expect to increase this number.

As for increased science requirements in high school, there is no question that this Administration believes that our children need greater challenges in school than they now receive. That means more mathematics and science, but it also means different mathematics and science in terms of curriculum and instruction. The key is to focus on what we expect students to know and be able to do. The development of national standards and the curriculum frameworks will do this. Whether increased requirements will be necessary to achieve our goals or whether a restructured curriculum and new instructional approaches can do it in the same or less time remains to be seen. My math and science initiative will train 770,000 teachers, and I have increased math and science education by 43% since 1990.

Our strategy endorses a broad range of activities stratified into three tiers. For grades K through 12, first priority is given to reform at the elementary and secondary education levels. I advocate activities such as:

- Development of curriculum, teaching, and assessment standards for mathematics and science, incentives for their implementation, and methods for measurement of performance against these standards.
- Development of model curriculum, course, and instructional materials to extend the framework.
- Support for teacher enhancement and preparation.

The problems of America's schools are, of course, not limited to the need for improvement in mathematics and science performance; nor will they be solved without a return to active participation by parents in the education of their children. In my America 2000 initiative, I have spelled out the kind of change that must take place in our schools, with particular emphasis on grades K through 12, if we are to look forward not only to a work force adequate to the jobs of the 21st century but also to a citizenry prepared to participate in, and more fully enjoy, the benefits of our democratic society.

CLINTON

nation's environmental performance is the concern of its neighbors.

With true U.S. leadership, we could have negotiated an effective treaty that would have both preserved the planet's biodiversity and protected the intellectual property rights of U.S. companies. As the country with the largest store of national wealth in patented technology, we lost an opportunity to take an active role in shaping international law for the protection of patents, copyrights, and technological advances.

Question 6

Do you expect to make changes in the White House science policy apparatus? In particular, will your science adviser remain at the level of Assistant to the President? Will your science adviser be involved in the selection of officials in top science posts in your Administration?

I have made a pledge to the American people to "reinvent" government—to make it more responsive to their needs and to the challenges of a rapidly changing social and economic environment. In this context, my science adviser will play a more critical role in overall government policy-making than ever before. I expect that the science adviser will play a role not only in determining policy but also in advising on the selection of top officials who will have science and technology responsibilities. In addition, I have stated on a number of occasions that I will give Vice President Al Gore the responsibility and authority to coordinate our overall technology, and by extension science, policy across all government agencies. Finally, the science adviser will have full access to the Vice President and me in the role of Assistant to the President.

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To encourage students to choose study in the demanding fields of science, math, and engineering, we need to ensure not only that they arrive at college academically prepared but also that they have some assurance that jobs in these fields will be available for them upon graduation. It is no accident that improvements in K through 12 education are an important part of the National Economic Strategy I have proposed for this country.

My commitment to educational reform can best be seen by my record as governor of the state of Arkansas. One component of this reform was to add more math and science courses to high schools and seek improvement in math and reading test scores. In the past decade, we have made great strides. While only 5,100 students were enrolled in advanced math courses in 1983, over 75,000 were enrolled in 1991. While the percentage of Arkansas seniors who went on to attend an Arkansas college was under 38.2% in 1982, this percentage had increased to 51.3% by 1991. In addition, Arkansas now ranks fifth in the nation in the ratio of computers to students in schools.

In the first 100 days of a Clinton-Gore Administration, we'll give Congress and the American people a real educational reform package. This package would include fully funding Head Start and other programs; establishing tough national standards and a national examination system to measure if those standards are met; and working to achieve the 1989 Education Summit's "National Education Goals" by the year 2000—one of these goals being that students should be knowledgeable about math, science, language, history, and geography when they graduate from high school.