



Head to head

The party conventions are over, and the candidates have been anointed. Now it's a straight race to the tape between President George W. Bush and his challenger John Kerry. *Nature* asked them where they stand on science.

In their frantic search for votes, George W. Bush and John Kerry are leaving no stone unturned. They've even been sparring over science, with Kerry raising the issue of embryonic stem-cell research at the Democrats' convention in July, and Bush accusing Kerry of flip-flopping on the site of a nuclear waste dump in Nevada soon after.

Sections of the scientific community have pitched in, with Kerry's campaign attracting vigorous support from a group backed by 48 Nobel laureates. The fact that most of this activity is on the Kerry side says a lot about recent political trends in the United States. This is a deeply divided country, and scientists and the university campuses that many of them inhabit have become distinctly unfriendly territory for the Republicans.

But scientists pride themselves on objectively assessing evidence. So, for the first time in *Nature's* history, we have given the candidates the chance to address researchers directly. From about 50 questions posed by our editorial staff, we selected 15 and asked the campaigns to respond in 1,500 words, distributed as they saw fit. Bush's answers were some 30% over length, and have been edited; Kerry kept to the limit and his responses are presented in full.

We hope that the result will give an inkling of what the candidates stand for. In some areas, such as the broad balance of science funding, there is not much to choose between them; in others, such as global warming, their respective stances could hardly be further apart.

These stances reach beyond domestic US issues. As the Hungarian-born financier George Soros observed two years ago: "In modern global capitalism, only Americans vote, Brazilians do not." What he meant was that when it comes to economic, military and other decisions, the US administration's actions are likely to have as much impact on your country as those of your own government.

That's why, this November, from the remotest province of China to the bustling capitals of Europe, so many eyes will be on America's votes. Let's hope they count them up right.

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Bush vs Kerry

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initiative to support nonproliferation, disarmament, counterterrorism and nuclear safety projects in the former Soviet Union. For nuclear weapons, the first step is to prevent access to fissile materials. We are making good progress in this area through efforts such as the Global Threat Reduction Initiative and our material security efforts in Russia.

KERRY: It is not a problem we will be able to solve alone. It is going to require American leadership that forges an international consensus on how to deal with these weapons and the often dual-use technology that underpins them. I will work closely with the scientific community to develop responsible oversight for biomedical research to make sure that deadly pathogens are only in the hands of those with legitimate research needs. Together we will find ways to reduce the possibility that scientific knowledge and capabilities will be misapplied to do harm.

4 Do you support research into new nuclear-weapon designs in the United States? If not, how do you see the future role of the three nuclear-weapons labs?

BUSH: Our national laboratories are doing great work to deal with the threats of the twenty-first century. These laboratories are also a tremendous asset in our efforts to improve homeland security, are the source of unparalleled technological progress, and are helping America win the War on Terror. The Nuclear Posture Review released by my administration in January 2002 noted that the nation's nuclear infrastructure had atrophied since the end of the cold war and that the evolving security environment requires a flexible and responsive weapons-complex infrastructure. To that end, my fiscal-year 2005 budget reflects an increase over 2004 in weapons activities.



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1 Is there a danger that increased controls on travel by scientists into the United States, introduced in response to homeland security concerns, will isolate US science and endanger US scientific leadership? If so, what can be done to keep US science open to the world?

BUSH: My administration values the contributions that foreign scientists and students make to our nation's scientific enterprise, while recognizing the importance of safeguarding our security. We will continue to welcome international students and scientists while implementing balanced measures to end abuses of the student visa system.

We have already achieved several notable successes in reducing delays now being experienced by some visa seekers. We have increased security while speeding up the clearance process — about 1,000 backlogged applications have already been cleared out.

KERRY: We can balance science and security. In the wake of 9/11, America took important steps to improve security for visa applicants to the United States. However, we can improve our visa system to process visa applications for legitimate scientists and students more quickly while still screening individuals who pose a genuine security risk. With more resources and better procedures, we do not need to face a trade-off between scientific exchange and national security.

2 Recent months have seen various charges of political bias against scientific panels that advise the US government at different levels. What would you do to

ensure that your administration receives genuinely impartial scientific advice?

BUSH: My administration has a strong commitment to the highest scientific standards in decision-making. On issues ranging from climate change to nanotechnology, I have sought out the best scientific minds — inside and outside the government — for policy input and advice, especially the independent National Academies. My commitment to sound, independent scientific advice is unwavering. And my senior science adviser in the White House, John Marburger, happens to be a Democrat.

KERRY: My administration would never utilize biased advice as a foundation for public policy. As president, I will serve on behalf of the public interest. In order to best serve the public, effective decisions must be made with the input of genuine impartial expert counsel.

3 What is the long-term solution to the gradual dissemination of knowledge about weapons of mass destruction — especially bioweapons?

BUSH: Stopping the gradual dissemination of knowledge is impractical if not impossible. The key to stopping the proliferation of weapons of mass destruction is preventing those seeking these weapons from gaining access to their most significant and technically challenging components. The redirection of former weapons scientists to productive civilian employment is a key priority.

My administration has launched the G8 Global Partnership — a \$20-billion

KERRY: I would end the pursuit of a new generation of nuclear weapons. Our national laboratories play a critical role in maintaining our existing stockpiles and assuring that our existing nuclear weapons are safe, secure and reliable. They also play and should continue to have an important role in preventing the spread of weapons of mass destruction and in advancing science for our nation's security.

5 Some physicists have questioned the capability of missile defence systems being deployed in the United States. Would you increase or decrease spending on missile defence, and would you subject claims made on its behalf to independent scientific review?

BUSH: Early in my administration, I called for the examination of the full range of available technologies and basing modes for missile defences that could protect the United States, our deployed forces, and our friends and allies. Our policy is to develop and deploy, at the earliest possible date, ballistic missile defences drawing on the best technologies available.

Later this year, the first components of America's missile defence system will become operational. This will fulfil a pledge I made to the American people more than four years ago. We will develop and deploy the technologies necessary to protect our people.

KERRY: I am not for rapid deployment of missile defence. We should not waste money on deployment at this point. I favour additional research, development and testing. As to the issue of independent scientific review, we have to be careful because of the classified nature of much of the work in question. At the very minimum, we must work hard to restore the credibility of the internal review process. The truth is the Bush administration has shredded its own credibility on this, particularly in its rush to deploy missile defence. We need to restore the credibility of our own review process and we need to subject systems to realistic, operational testing to make sure that they really work.

6 Should the United States participate fully in the construction of ITER, the proposed fusion research facility, and

what steps would you take to help such international scientific projects to succeed?

BUSH: I committed the United States to join ITER early in 2003. ITER is a critically important experiment to test the feasibility of nuclear fusion as a source of electricity and hydrogen. Along with several other nations, the United States is playing a critical role in launching ITER. In fact, ITER is the Department of Energy's top facilities priority.

KERRY: My energy plan will tap America's initiative and ingenuity to strengthen our national security, grow our economy and protect our environment. With regard to ITER, John Edwards and I support a strategically balanced United States fusion programme that includes participation in ITER to supplement a strong domestic fusion science and technology portfolio. As president, my first priority internationally on this and other energy issues will be to engage other nations to find areas of cooperation and common ground.

7 Do you think the United States should send astronauts to the Moon or Mars in the next 10 to 15 years? If so, why send humans instead of robots? If not, what is the purpose of the space shuttle and space station?

BUSH: In January, I announced my vision for the future of America's space exploration programme. As we complete our work on the International Space Station, we are developing a new manned exploration vehicle to explore beyond our orbit. This vehicle will be tested by 2008 and will conduct its first manned mission no later than 2014. America will return to the Moon as early as 2015 and no later than 2020, and use it as a foundation for human missions beyond the Moon. We will begin with robotic missions, and manned missions will follow. An extended human presence on the Moon could reduce the costs of further exploration.

KERRY: Today, thanks to decades of public investment in space exploration activities, a rotating international team of astronauts is living and working in space on the International Space Station, a dozen Americans have walked on the Moon, we have rovers exploring the surface of Mars and an armada of spacecraft continues to



explore our Solar System. NASA is an invaluable asset to the American people and must receive adequate resources to continue its important mission of exploration.

However, there is little to be gained from a space initiative that throws out lofty goals, but fails to support those goals with realistic funding. John Edwards and I are committed to increasing funding for NASA and space exploration because it not only makes critical contributions to our economy, it also expands our understanding of the world we live in.

8 Some researchers have expressed concern over what they see as a growing disparity between funding for biomedical research and other fields, including the physical and environmental sciences. Do you agree that this a problem and, if so, what would you do about it?

BUSH: My administration is committed to funding basic research and has listened to concerns from the scientific community and lawmakers to ensure that there is a federal priority on funding for physical sciences as well as life sciences. My budgets have sent a strong signal that we are addressing the concerns.

KERRY: John Edwards and I would increase federal funding at both the National Institutes of Health and the National Science Foundation (NSF). To ensure we remain strong in the sciences and engineering, I would specifically increase NSF funding for the physical and environmental sciences, and double the NSF graduate scholarships for mathematics and science.

We must not short-change our national investment in future medical and technological breakthroughs. It will be scientific discoveries that will drive our

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future economy — just as the discoveries of electricity, the combustion engine and the Internet drove our economy in the past.

9 Many environmental problems can be attributed to high levels of consumption in developed nations such as the United States. Can science and technology allow everyone on the planet to reach these levels of consumption? Or do Americans need to change their lifestyles and consume less?

BUSH: America in a very real sense has changed, not by consuming less, but by consuming and producing smarter. We have proven that economic growth makes possible the environmental progress our country has achieved and will continue to achieve in the future.

Under my leadership, America has entered productive international partnerships to assist developing countries in building more modern energy systems. Given the enormous gains of the past century, I do not and would not underestimate the enormous potential of science and technology to continue to make possible improved living standards for people all over the world.

KERRY: John Edwards and I believe that we can protect our environment while strengthening our economy. Time and time again, America has met environmental challenges through ingenuity and technological innovation. But it takes strong leadership to put the interests of protecting public health and the environment ahead of the interests of polluters, and as president I will reverse the four years of environmental neglect by the Bush administration. I have been a leader in the fight to strengthen our

economy and protect our environment, fighting to clean up toxic waste sites and to keep our air and water clean.

10 Does the Endangered Species Act need to be amended in order to operate more effectively? If so, how would you amend it?

BUSH: We need to modernize the act so that it provides the greatest benefits to those species most in need. For example, productive reforms could include habitat conservation plans, conservation banking, voluntary agreements with landowners, and partnerships with states, tribes and nongovernmental organizations. These programmes could provide far greater conservation benefits while avoiding unnecessary regulatory, economic and social burdens.



KERRY: John Edwards and I support protecting wildlife and the important goals of the Endangered Species Act. We will implement the act in a cooperative manner that extends the benefits of wildlife and habitat protection to public and private lands. With adequate funding and a cooperative approach that works for both wildlife and property owners, we will continue America's strong legacy of protecting wildlife.

11 Most Americans accept transgenic crops as safe to eat, transgenic salmon are being developed for sale as food, and genetically modified fish that glow in the dark are being sold in pet shops. At what point does genetic modification of plants and animals become problematic to you?

BUSH: Biotechnology plays an extremely important role in reducing environmental impacts of farming and meeting the world's increasing demand for food. But I believe it is important that our regulatory framework keeps pace with science. The agriculture department's Animal and Plant Health Inspection Service has begun developing a wide-ranging environmental impact statement to assess the effectiveness of biotechnology regulations. This will help the federal government better understand risks and benefits.

KERRY: John Edwards and I will work towards the goal of reducing the ecological footprint of agriculture and ensuring

adequate and safe food and sustainability.

We will redouble government efforts to make sure biotechnology is safe for human consumption and safe for the environment. We will give government agencies the power they need to effectively regulate genetically modified food products, both before and after market. And we will work with the international community to effectively address its concerns and improve trade relations.

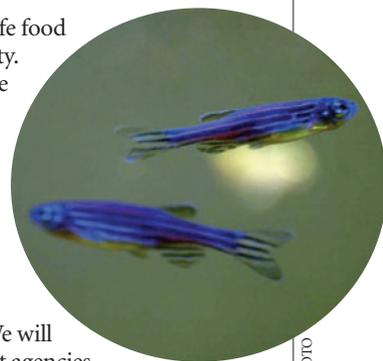
12 Are greenhouse gases generated by the burning of fossil fuels the main cause of global climate change? Is this an important problem for the United States and, if so, what would your administration do to limit emissions of greenhouse gases at home and abroad?

BUSH: Global climate change is a serious long-term issue. In 2001, I asked the National Academy of Sciences to provide the most up-to-date information about the science of climate change. It found that considerable uncertainty remains about the effect of natural fluctuations on climate and the future impacts climate change will have on our natural environment.

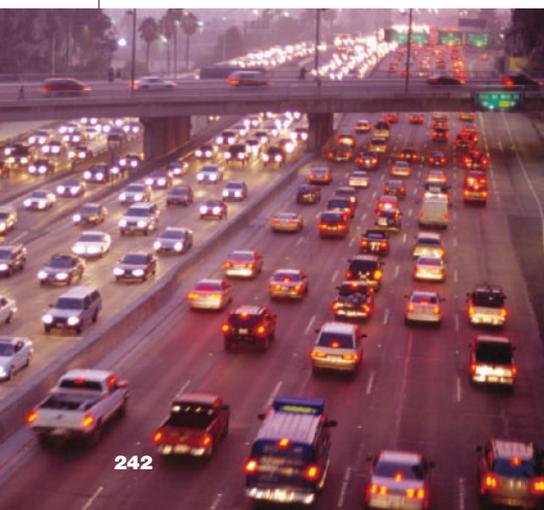
My administration is now well along in implementing a comprehensive climate-change strategy to advance the science, expand the use of transformational energy and carbon sequestration technologies, and mitigate the growth of greenhouse-gas emissions in the United States and in partnership with other nations.

I created the new US Climate Change Science Program (CCSP) to refocus the federal government's climate research programmes. The National Academy endorsed the CCSP, noting that it "articulates a guiding vision, is appropriately ambitious, and is broad in scope". I also committed the nation to a goal of reducing American greenhouse-gas intensity by 18% over the next ten years.

KERRY: The scientific evidence is clear that global warming is already happening and rising levels of global warming pollution are making the problem worse. For years in the Senate, I have worked with our allies to fight for a balanced global warming treaty. President Bush rejected the Kyoto Protocol, stubbornly walking away from



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the negotiating table altogether. John Edwards and I will take the United States back to the international negotiating table while working at home to take concrete steps to reduce pollution, setting concrete limits to halt and reverse the growth in global warming pollution and tapping the ingenuity of American industry.

13 The Food and Drug Administration (FDA) constantly has to balance the desire for rapid approval of new drugs against the need to ensure their safety. Is the current system getting this balance right? If not, how does it need to change?

BUSH: Today, the FDA sets the world's gold standard for speeding new therapies to patients and ensuring the safety of the drug supply. In 2003, the FDA approved 466 new and generic drugs and biological products, while decreasing the time it took to review and approve most applications. In addition to evaluating new drugs for safety and efficacy, the FDA is now directing monitoring efforts to the 10,000 drugs that are already on the market.

KERRY: As president, I will ensure that the FDA has the resources it needs to approve drugs in a safe and timely manner. In the US Senate, I sponsored and supported legislation that requires drug manufacturers to pay fees to the FDA and allows the agency to hire more reviewers and significantly accelerate drug reviews and approvals. Under the Prescription Drug User Fee Act, new drugs are being approved rapidly by the FDA — and I believe that more should be done to assure the safety of those drugs once they are marketed.

The biggest threat to our success in expanding patient access to medical breakthroughs is the Bush administration's ideological approach to scientific decision-making. When it comes to the safety of our medicines and food supply, the public health is taking second place to special interests and ideological agendas.

John Edwards and I support a return to sound science at the FDA and throughout the federal government.

14 Is mad cow disease, and its possible transmission to people, a significant potential public health threat in the United States? If so, what steps would you take to ensure its containment?

BUSH: My administration is taking aggressive actions to protect American consumers against

so-called 'mad cow' disease (BSE). Last December, after the discovery of BSE in one cow in Washington state, the Department of Agriculture (USDA) took steps to further assure the safety of our beef, including banning from the human food chain so-called 'downer cattle' and prohibiting specified risk material from animals over 30 months in age. I also called on an international review team to assess the BSE situation and at its recommendation USDA launched an expanded surveillance programme of high-risk cattle populations.

KERRY: Reports of the Bush USDA's mishandling of mad cow disease have underscored the need to protect American consumers. John Edwards and I will improve our food safety and inspection process,



including not only the meat-packing side but also more coverage to ensure that the 1997 feed ban on ground bone-meal is not being violated. We will increase the testing and inspections overall and enhance the BSE surveillance programme so that all suspect animals are analysed. And we will implement an aggressive timeline for establishing a national tracking system that would make diseased livestock and meat easier to track and contain.

15 Members of the House and the Senate have each asked the president to revisit the policy on embryonic stem-cell research that

was announced on 9 August 2001. If elected, would you change this policy and, if so, how?

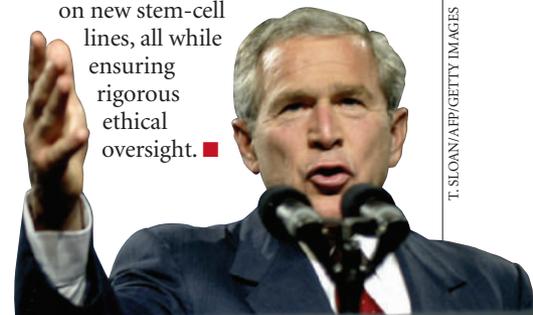
BUSH: I am committed to pursuing stem-cell research without crossing a fundamental moral line, and I am the first president to provide federal funding for human embryonic stem-cell research. However, stem-cell research is in a very early stage and while it may hold great promise we should not overstate the state of the science, or politicize these issues, because it gives false hope to individuals and families suffering through terrible illnesses.

Last year, the federal government invested \$25 million in embryonic stem-cell research and nearly \$191 million in adult stem-cell research. And these efforts are matched with millions more dollars spent in the private sector. My administration is also creating a national embryonic stem-cell bank.

These efforts are providing a boost to research in a very promising new field, while not providing taxpayer funding that would sanction or encourage further destruction of human embryos. My policy makes it possible for federally funded researchers to explore the potential of embryonic stem cells, while respecting the ethical and moral implications associated with this research.

KERRY: Today, millions of children and adults suffer from incurable diseases such as diabetes, Parkinson's, Alzheimer's, heart disease, cancer and spinal-cord injuries. John Edwards and I believe that we must lift the barriers that stand in the way of science and push the boundaries of medical exploration so researchers can find the cures that may exist. I will lift the ideologically driven restrictions on stem-cell research created by the Bush administration by overturning the ban on federal funding of research

on new stem-cell lines, all while ensuring rigorous ethical oversight. ■



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