Many factors can make or break a U.S. presidential candidate in the 2008 race for his or her party’s nomination. The ability to raise millions of dollars is key, as are positions on megaissues such as the Iraq war, immigration, and taxes. Voters also want to know if a candidate can be trusted to do the right thing in a crunch. Science and scientific issues? So far, with the exception of global warming, they are not getting much play.

“It’s pretty hard to find a candidate from either party who is gung ho for science,” laments Representative Vernon Ehlers (R–MI), one of two Ph.D. physicists in Congress and an indefatigable promoter of science and technology. (As a supporter of Mitt Romney, whose father was governor of Ehlers’s home state of Michigan back in the 1960s, Ehlers will be trying to pump science and technology into his campaign.)

But just because science isn’t on the front burner in this year’s seemingly interminable election campaign, that doesn’t mean the community should tune out. The candidates are addressing issues, from climate change to how the next Administration should manage science, that will affect researchers next year—and for decades to come. Differences have emerged on embryonic stem cell research, on the urgency of combating climate change, and even on the teaching of evolution.

What are they saying on the stump, and how would they govern? This special report tries to answer those questions by examining the leading contenders among the Democrats and the Republicans, in alphabetical order, based on recent polls identifying those with a plausible shot at their respective nominations. (We’ve also provided basic information on the rest of the field.)

Although none of the campaigns afforded us direct access to the candidates themselves—a telling indicator of the importance of science in the campaign, perhaps—we’ve talked to some of their advisers, as well as to colleagues, friends and foes alike, who are familiar with their careers.

By the time you read this, some of the candidates may have surged, and others may have slumped. However, the issues seem likely to remain relevant no matter who becomes the 44th president of the United States.

—JEFFREY MERVIS
HILLARY CLINTON’S SPEECH AT THE CARNEGIE INSTITUTION of Washington on 4 October, the 50th anniversary of the launch of Sputnik, was the most detailed examination of science policy that any presidential candidate has offered to date. That’s not surprising, however, given the extensive network of former advisers to her husband that the Democratic front-runner has tapped.

Their voices could be heard in Clinton’s emphasis on innovation to drive economic growth, a bottom line that is as much a creature of the 1990s as grunge music. And the senator from New York linked her call for Americans to better “compete and innovate” in science to a post-Sputnik plea by President Dwight Eisenhower for “heroism, sacrifice, and accomplishment when the chips are down.”

But campaign adviser Thomas Kalil, formerly a technology official in the Clinton Administration and now an administrator at the University of California, Berkeley, insists that the candidate’s science platform is not stuck in the past. “2008 is not 1992,” he says. “There are a new set of challenges.”

Those new challenges include reducing the country’s dependence on foreign oil, responding to climate change, and reversing what Clinton calls the Bush Administration’s “assault on science.” To address the first two, Clinton has proposed a $50 billion research and deployment fund for green energy that she’d pay for by increasing federal taxes and royalties on oil companies. She would also establish a national energy council to oversee federal climate and greentech research and deployment programs. Both steps, she says, would help achieve the goal of an 80% reduction in carbon emissions from 1990 levels by 2050 and use tax credits, regulations, and carbon caps to create “5 million new jobs in clean energy over the next decade.”

Last month, as a member of the Senate Environment and Public Works Committee, she voted for a bill almost as aggressive that passed along party lines, although the panel failed to adopt several amendments she offered (Science, 14 December, p. 1708).

To end what she calls President George W. Bush’s “open season on open inquiry,” the 60-year-old lawyer and former first lady says that her science adviser would report directly to her rather than be “filtered through political advisers.” Government advisory committees must not be hamstrung by political considerations, she adds, which she insists has happened repeatedly since Bush took office. In her Carnegie speech, she also promised an executive order that would “ban political appointees from altering or removing scientific conclusions in government publications without any legitimate basis … and prohibit unwarranted suppression of public statements by government scientists.”

But science policy expert Roger Pielke Jr. of the University of Colorado, Boulder, says her efforts to stop political meddling are poorly defined and won’t work. “What is ‘legitimate’ and ‘unwarranted’?” he asks. “As written, [the proposal] is a political Rorschach test.”

Clinton Administration-era official Ellis Mottur helped the campaign prepare her package of proposals, and Kalil and former White House science officials Neal Lane and Henry Kelly, who is now head of the Federation of American Scientists, were among a crew of unpaid advisers who offered input. Mottur says that he expects “the science-technology issues will come more to the fore in the general election.”

In the meantime, Clinton has called for another doubling of the $30-billion-a-year National Institutes of Health budget during the next decade, the preservation of the NASA team involved in the shuttle program even as the agency shifts to new exploration missions, and the augmentation of NASA’s earth science and aeronautics programs. But finding the money won’t be any easier than mustering the political will to tax energy companies, Pielke predicts. “Good luck finding room in the R&D budget for all of that,” he says.

However, supporting good research isn’t just about money, says physicist David Moncton, director of the Nuclear Reactor Laboratory at the Massachusetts Institute of Technology and a former administrator at two national laboratories. Just as important as any budget, says Moncton, who is not advising the campaign, are “competent individuals managing [science policy].” And Moncton thinks “that might be more likely to happen with a Hillary Clinton [presidency].”

–ELI KINTISCH

Information on Other Candidates in the Race:

DEMOCRATS JOE BIDEN, CHRIS DODD, MIKE GRAVEL, DENNIS KUCINICH >> 27

REPUBLICANS DUNCAN HUNTER, ALAN KEYES, RON PAUL >> 29
JOHN EDWARDS MADE A FORTUNE AS A PERSONAL-INJURY lawyer in the 1980s and was John Kerry’s vice president on the unsuccessful Democratic presidential ticket in 2004. But this year, he is campaigning as a populist and a Washington outsider.

The son of mill workers, Edwards pounds away at the “big, powerful interests,” the “corrupt,” and the “very greedy” in his standard stump speech. The 54-year-old former North Carolina senator (1998–2004) wants to make sweeping changes, some of which would affect research. He would end what he calls the “antiscience” practices of George W. Bush’s Administration—such as “censoring research and slanting policy on climate change, on air pollution, on stem cell research.” And he would increase science funding. Despite such promises, however, biomedical researchers who remember the malpractice lawsuits that Edwards championed 2 decades ago—some of which were based on questionable science—are wary.

If Edwards actually does move into the White House, he says his own presidential science adviser would have more clout than the current one and would play “a central role as an assistant to the president.” To protect scientific integrity, Edwards would “eliminate political litmus tests for government scientists” and forbid political appointees “from overriding agencies’ scientific findings unless the chief White House science adviser concludes they are erroneous.”

Edwards’s agenda for improving the U.S. economy includes a mixture of very specific projects and broad promises. For example, he advocates a low-cost “universal Internet” for rural communities and more research on autism and fragile X syndrome, a genetic cause of mental impairment. He favors federal funding of human embryonic stem cell research, including nuclear DNA transfer. He wants to create a universal, federally backed health system. And his spokesperson, Audrey Waters, says he supports budget increases “substantially better than the pace of inflation” for the

REPUBLICAN

RUDOLPH GIULIANI

Most Recent Job: Founder and Executive, Giuliani Partners  Age: 63

SPEAKING “IN THE MOST HUMBLE WAY POSSIBLE,” RUDY Giuliani disclosed on the campaign stump in Iowa last summer that “I’m very good at doing the impossible. I am.” Indeed, he’s made a career of slaying dragons, including winning the convictions of prominent Wall Street and organized crime figures as a federal prosecutor in the 1980s and overseeing a huge drop in New York City’s crime rate as its mayor from 1993 to 2001.

So what does this 63-year-old dragon slayer make of science? That’s hard to determine because his campaign successfully discouraged key advisers from speaking to Science about specific issues. But his public career suggests that Giuliani is a pragmatist with a quick grasp of issues, a lover of statistics, and a firm believer that most tasks can be done better by private institutions than by government.

On social issues, Giuliani stands out among the Republicans for what he has said about abortion: With reservations, he would let the woman decide what to do. On a linked topic, research on human embryonic stem cells, he said in May that “as long as we’re not creating life in order to destroy it—as long as we’re not having human cloning … I would support [federal funding].” David Carmel, a biotech executive and member of the board of the New York Stem Cell Foundation, made the case for embryonic stem cell research in a private debate last fall that the candidate staged to explore both sides of the issue. Based on Giuliani’s questions, Carmel says he believes Giuliani, if elected, would reduce federal restrictions.
On environmental policy, Edwards has won the “enthusiastic endorsement” of Friends of the Earth Action, the nonprofit group’s political arm. That support is based in part on his proposal to cut greenhouse gas emissions by 80% by 2050, using a cap-and-trade system to auction off permits as a regulatory incentive. Edwards says he would take at least $10 billion a year from that auction and another $3 billion from other sources to invest in a trust fund for new technologies. It would develop solar, wind, and “cellulose-based biofuel” projects.

The environmentalists are also pleased with what Edwards would not do. He opposes any expansion of nuclear power, the candidate explained in a recent debate, because it is “extremely costly ... and we don’t have a safe way to dispose of the nuclear waste.” Liquefied coal is out, too, he says, because “the last thing we need is another carbon-based fuel.”

Yet among scientists, Edwards “carries some baggage,” says Peter Agre, a Nobel Prize–winning biochemist now at Johns Hopkins University in Baltimore, Maryland. Although Edwards is a “good man,” says Agre, “I know people who would never vote for him” because of the way he and other lawyers pursued and won multi-million-dollar medical malpractice awards representing children born with cerebral palsy.

In a 1985 case, for example, Edwards addressed the jury in the voice of a brain-damaged child, describing from within the womb how she waited for a doctor to perform a cesarean section as a fetal heart monitor signaled her distress. The doctor was accused of waiting too long; the jury awarded $6.5 million. Many such suits were “fueled by bad science,” says neurologist Karin Nelson of NIH, who concedes she has not reviewed the specific cases that Edwards handled. She says that the same type of cerebral palsy litigation has now spread to Europe—to the detriment of children’s health, she believes. Nelson sat on a panel of the American College of Obstetricians and Gynecologists that in 2003 found that most cases of cerebral palsy are not caused at birth.

Asked today about Edwards’s courtroom tactics, his staff points to statements from his vice presidential campaign. Speaking then about his legal team, Edwards claimed that “we would take months investigating” any brain-injury case before deciding whether to accept it. And he said he only litigated those that “were merited.”

—JOCELYN KAISER AND ELIOT MARSHALL

Giuliani’s record as mayor and author add few clues about his outlook on science. Rodney Nichols, former president of the New York Academy of Sciences (NYAS), gives him high marks for his interest in two city-backed projects involving science and somewhat lower marks for follow-through. Nichols recalls how the mayor agreed to host an NYAS award to honor scientific excellence, even though it “would not win [him] votes.” At the same time, Nichols says that “not much came” of a panel on how to bring biotech companies into the city, as the mayor lost interest once local medical institutions began to jockey for concessions.

In his 2002 book Leadership, Giuliani wrote, “I loved learning biology” as a premedical student at Manhattan College. But in the end, he says that he chose law school and politics because “I liked ideas better than science.” New York City invested heavily in crime statistics—a system called CompStat—to help command a burgeoning police force. The model has been copied in many cities, and Giuliani has proposed clones for other tasks, which he calls JobStat, SchoolStat, EnergyStat, and HealthStat.

The technical issue that proved most controversial for Giuliani this fall, in fact, involved his use of health data. An ad in New Hampshire claimed that people diagnosed with prostate cancer (as he was in 2000) in the United Kingdom are more likely to die of their disease because of its system of “socialized medicine” than their U.S. counterparts. The ad cited survival rates of 82% for the United States and 44% for Britain. This provoked a flurry of criticism. A spokesperson for Giuliani revealed that the candidate found the data in the journal of the Manhattan Institute for Policy Research, a conservative think tank to which he has close ties.

Experts say it’s easy to misread the numbers. Recent data from the U.S. National Cancer Institute and an international survey called Eurocare indicate that the 5-year survival rates are about 77% for Britain and 98% for the United States. What this shows, according to biostatistician Donald Berry of the M. D. Anderson Cancer Center in Houston, Texas, is that U.S. doctors screen and diagnose more patients, finding prostate cancer in people not at risk of dying from it, and that “there is no credible evidence that screening decreases prostate cancer mortality.” The Giuliani campaign has said it won’t stop using the original ad data.

Giuliani’s campaign has skated lightly over most issues with scientific and technological components. On energy, for example, he would boost all domestic energy sources, emphasizing coal, nuclear power, ethanol (with a goal of 20% more output), and renewable sources such as windmills, but he has not spelled out how this would work. Likewise, his pledges to “promote science and mathematics through technical certification or an associate degree” and “expand the number of H-1B visas for skilled foreign workers” come with few details. The League of Conservation Voters reports that Giuliani has “no articulated position” on most of the environmental issues it tracks. Giuliani has said, “I do believe there’s global warming,” but he has not spelled out his response to the problem.

—ELIOT MARSHALL
HE FIRST TIME MIKE HUCKABEE WAS ASKED IN A national candidates’ debate if he believed in evolution, he raised his hand to say that he didn’t accept the theory. The second time, Huckabee initially ducked the question and instead replied, “I’m not planning on writing the curriculum for an 8th grade science book.”

Scientists in Arkansas who know Huckabee from his decade as governor say the response is consistent with his approach to many social issues: Take a strong stance but don’t impose your views on others. The former president of the Arkansas Baptist State Convention holds many staunchly conservative positions, including support for displaying the Ten Commandments in public schools and opposition to the use of embryonic stem cells for research. But when it comes time to act, Huckabee has often veered toward the center of the political road.

JOHN MCCAIN DOESN’T HAVE ANY SCIENTIFIC TRAINING OR expertise. But he trusts the experts. They’ve told him that global warming is the most urgent issue facing the world, and that makes climate change one of the three issues—along with immigration and the Iraq war—that he’s emphasizing in his presidential campaign.

The 71-year-old retired Navy pilot turned Arizona politician discovered the issue during his previous, unsuccessful run for the White House in 2000, says his economic adviser, Douglas Holtz-Eakin, a former director of the Congressional Budget Office. It’s popular lore that the candidate woke up to the issue when confronted by a Dartmouth College student dressed as a penguin at an event that year in New Hampshire. In fact, says Holtz-Eakin, McCain got the message “again and again” during the campaign.

McCain used his position on the Senate Commerce Committee, which he chaired from 2003 to 2005, to focus attention on the subject and has led congressional delegations to both poles to witness its impact. “He’s a very quick learner in spite of his record at the Naval Academy,” says Timothy Profeta, a former staffer for Senator Joseph Lieberman (I–CT) who now runs Duke University’s Nicholas Institute for Environmental Policy Solutions.

McCain equates environmentalism with national security. And although he has been a staunch supporter of President George W. Bush’s stance on the Iraq war, his views on climate change have triggered some sharp exchanges with Bush Administration officials. In 2002, he declared that White House science adviser John Marburger’s comments on global warming, which many scientists saw as overly cautious, had “no credibility” in light of the growing severity of the problem. In a 2005 hearing, he accused Vice Admiral Conrad Lautenbacher, head of the National Oceanic and Atmospheric Administration, of having a “complete lack of concern about future generations of Americans who are affected by climate change.”

As chief executive of this largely rural state from 1996 to January 2007, Huckabee persuaded a Democratic-led legislature to expand health coverage for poor children and raise taxes to improve schools and roads and unsuccessfully campaigned for teenage immigrants who did not have proof of citizenship to receive college vouchers after graduating from high school. Those positions were anathema to many of his constituents and a pleasant surprise to others. “He really was much less radical and ideological than we all expected,” says Rita Sklar, executive director of the ACLU of Arkansas in Little Rock. He also supported a bond program to help improve infrastructure at universities.

That centrism is being tested now that Huckabee is on a national stage. Seeking to expand his base among evangelicals, for example, he has promised to fight for constitutional amendments that would ban abortion and gay marriage.
One issue dear to his heart has been the promotion of healthy living. When the Arkansas legislature rejected his proposal to use millions of dollars in tobacco-settlement funds for health care and medical research, he exercised his right as chief executive to call for a referendum, which passed handily. That effort only intensified after he was diagnosed with type 2 diabetes and shed 110 pounds.

“[He] would certainly be a friend” of the National Institutes of Health as president, says G. Richard Smith, who helped with the referendum and now directs the psychiatric research institute at the University of Arkansas for Medical Sciences. On the campaign trail, Huckabee has talked about funding disease-prevention efforts along the lines of the indoor smoking ban he signed into law while governor.

In a presidential debate and in a television interview, Huckabee sidestepped questions about whether human actions are behind climate change, but he supported a 2006 statement by the National Governors Association calling for more climate change research. “Our responsibility to God means that we have to be good stewards of this Earth,” he said in a May debate. That attitude, say environmental advocates, is a marked shift for someone who, as governor, declined to take sides in a court battle with Oklahoma about pollution in the shared Illinois River.

A free-trade advocate, he has sponsored a bill to restrict taxes on Internet use. He also wants to make better use of cyberspace to advance the cause of free-dom in the tradition of Radio Free Europe. In keeping with his stance on immigration, he has also been involved in expanding H-1B visas for foreign science graduate students studying in the United States.

Sometimes the interests of science take a back seat to those of his constituents. He’s supported an amendment to the Native American Graves Protection and Repatriation Act that could make it easier to turn over ancient human remains that are unrelated to existing American Indians to tribal representatives, a step that researchers worry will make the remains off limits. And McCain has waffled on the teaching of evolution. In 2005, he told the Arizona Daily Star that “there’s nothing wrong with teaching different schools of thought [on] ... how the world was created.” But the next year, he opined that creationism should “probably not” be taught in science classes.

—CONSTANCE HOLDEN

R E P U B L I C A N

MIKE HUCKABEE

Home State: Arkansas
Web site: mikehuckabee.com
Most Recent Job: Governor
Age: 52

—JENNIFER COUZIN

A free-trade advocate, he has sponsored a bill to restrict taxes on Internet use. He also wants to make better use of cyberspace to advance the cause of free-dom in the tradition of Radio Free Europe. In keeping with his stance on immigration, he has also been involved in expanding H-1B visas for foreign science graduate students studying in the United States.

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—CONSTANCE HOLDEN
PEAKING LAST SUMMER TO A CONVENTION OF BLOGGERS IN Chicago, Barack Obama accused the Bush Administration of ignoring or distorting data to shape its decisions on science-related issues. He promised the audience that his policies would be based on “evidence and facts.” Political rhetoric? Perhaps. But some scientists who have seen the first-term U.S. Democratic senator in action say that’s how he operated as a community activist in Chicago and as an Illinois state legislator.

Eric Whitaker, a research administrator at the University of Chicago and former director of the Illinois Department of Public Health, points to a 2004 proposal before the state legislature to offer free flu shots to everyone without health insurance during a shortage of the vaccine. Obama, then chair of the Health and Human Services Committee in the state senate, pressed Whitaker and others on their advice that the shots be limited to high-risk groups. “He pushes you to defend your data,” says Whitaker. In the end, Obama was convinced by their argument that vaccinating everybody would be economically unwise and bucked the majority in voting against the proposal.

Deborah Burnet, a pediatrician at the University of Chicago who studies the connection between obesity and diabetes, says Obama displayed the same evidence-based philosophy whenever she invited the Harvard Law School grad and community organizer to lecture her class on racial disparities in health. The 30-something Obama would urge her students to think about “how to use scientific inquiry to make intelligent public policy,” says Burnet. She says she was so inspired by his message that students should apply “insights from scientifically collected evidence” to real-world problems that she began a program to help low-income residents make better nutritional choices.

Obama’s campaign sets out a number of lofty science policy goals that might be difficult to achieve in that real world, however. He’d like to double federal spending on basic research and help more Americans get on the Web by broadening Internet access. He also wants to spend $18 billion on education initiatives covering everything from early childhood learning and precollege math and science instruction to attracting more minority students into science and engineering. Ironically, he’d pay for it in part by delaying NASA’s program to return to the moon and explore Mars—a project that would employ thousands of scientists and engineers.

Like the other Democratic contenders, Obama has made global warming an important part of his campaign. He supports a market-based carbon-trading system to cut carbon emissions to 80% below 1990 levels by 2050 and wants to invest $150 billion to develop biofuels. But he’s also suffered some political bumps and scrapes along the way to that position.

Last year, for example, Obama introduced a bill to subsidize the conversion of coal to liquid fuel, arguing that it would make the United States less dependent on foreign oil. But environmentalists saw it as a sop to the multibillion-dollar coal industry in his home state. Obama then backtracked, rigorously. I don’t think the state budged very much,” notes physicist Dennis Erickson, on detail as science adviser, who remembers being given 24 hours to clean out his desk. Despite having a year’s work go down the drain, Erickson doesn’t disagree with what the governor did. “I have nothing but good feelings toward him,” says Erickson, now retired and a contributor to Richardson’s presidential campaign.

Supporters say the incident demonstrates that the 60-year-old Hispanic politician is a principled manager, a tough negotiator, and someone who doesn’t see a conflict between national security and the environment. But some wonder if it is also the portrait of someone who acts precipitously, punishing critics and putting principles above results.
saying he would support liquefying coal only if the net carbon dioxide emissions from producing and burning the fuel were 20% lower than levels generated by petroleum-based fuels.

Reelected easily in 2006, Richardson has promised voters that he will shake up the Washington establishment. But he’s hardly a fresh face. After earning a bachelor’s and a master’s degree (in public policy) from Tufts University, Richardson spent nearly 30 years working for the federal government, first as a Democratic staffer, then as a seven-term congressman, and finally, as U.N. ambassador and energy secretary in the second Clinton Administration.

The most striking part of his résumé is his extensive, hands-on negotiations with regimes in North Korea, Iraq, and Sudan for the release of U.S. prisoners and other human-rights issues. Richardson has also taken a very aggressive stance on climate change, including calls for a 90% reduction in U.S. greenhouse gas emissions by 2050 through a cap-and-trade system, a 50% cut in oil consumption by 2020, greater reliance on renewable energy sources by utility companies, and federal subsidies to promote plug-in hybrid cars. “There is no free market when it comes to greenhouse gas emissions,” says Farquhar. “We need rules and boundaries.”

To help meet those goals, Richardson has proposed a $10 billion to $15 billion trust fund to support new energy technologies, replenished by the fruits of successful investments. But Farquhar says it’s not a honey pot for academic researchers, as the fund would pursue a more product-oriented approach than the Advanced Research Projects Agency–Energy created last summer. Farquhar says Richardson also plans to “reconfigure” DOE to deal with the twin challenges of energy independence and global warming, possibly shifting DOE’s ethanol program to the agriculture department and giving the Environmental Protection Agency a bigger role in climate change.

The lack of specifics is characteristic of someone who, in the words of one former aide, “has more ideas than time to implement them.” That’s equally true for his education platform. His response to the president’s signature No Child Left Behind program to improve elementary and secondary schools is characteristically blunt: “Scrap it.” But when asked what would replace the annual testing regimen and penalties for schools that don’t make the grade, his answer is a call for a national summit to work out the details. His promise to “hire 100,000 new science and math teachers [and] create 100,000 new science and math teachers” likewise ignores the fact that state and local authorities, not the federal government, hire teachers and run schools.

Despite repeated campaign statements about the importance of innovation, Richardson isn’t above embracing his own scientific illiteracy as a way to identify with the average voter. In his new book on energy, Leading by Example, Richardson asserts that more people would use energy-saving technologies, including light-emitting diodes, if they were given simpler names. “Does anyone on Earth know what a diode is?” he writes. “Probably someone at the two national labs in New Mexico, but not me! And probably not you.”

—JEFFREY MERVIS

Observers say the awkward shuffle reflects Obama’s relative inexperience in national politics. “It was naïve of him to think that he could side with the coal industry to please voters in his home state and not land in a frying pan on the national stage,” says Frank O’Donnell of Clean Air Watch, a Washington, D.C.–based nonprofit. Nonetheless, O’Donnell says, the senator’s green credentials are still pretty solid.

Since winning his U.S. Senate seat in 2004, Obama has continued to track health policy issues. He has proposed or supported legislation to promote embryonic stem cell research, increase research on avian influenza, and develop microbicides to protect women from HIV/AIDS. The measures suggest that Obama has retained his strong interest in applying science to public health challenges. For academic health centers, says Burnet, that means “getting the translational component going.”

—YUDHIJIT BHATTACHARJE
In 2000, when House Republicans wanted to pull the plug on the $1.4 billion Spallation Neutron Source (SNS) being built at the Department of Energy’s Oak Ridge National Laboratory in Tennessee, the state’s congressional delegation went to bat for the project. Fred Thompson, then one of the two Republican senators from Tennessee, was “extremely helpful” in assigning staff to work the issue, recalls physicist David Moncton, then head of the SNS project. But Moncton, now a professor at the Massachusetts Institute of Technology, remembers something else about his interaction with the senator on SNS, which staved off the threat and opened last year. “The issue [for Thompson] was this billion-dollar project was happening in Tennessee,” says Moncton. “There was no discussion of how intrinsically interested he was in science.”

Rick Borchelt, a longtime Democratic aide and former spokesperson for the Department of Energy lab, concurs. “He’s pretty much a cipher on science and technology,” says Borchelt.

The 65-year-old Tennessee native has played the president—as well as a military officer and a hard-nosed district attorney—during a long television and film career. He’s also been a lawyer, lobbyist, and talk-show host after coming to Washington in 1973 as a Republican staffer during the Watergate hearings. Since jumping into the race for president last summer, he has rarely addressed science issues. But Norman J. Ornstein of the American Enterprise Institute in Washington, D.C., who worked with Thompson when he chaired what was then called the Government Affairs Committee, credits him with being “knowledgeable and insightful” on the often thorny issues that came before the panel. “I found him to be quite engaged on issues he cared about,” says Ornstein. “But he was not a guy who stuck around if he didn’t need to.”

Last month, as Mitt Romney campaigned in Iowa, he laced his stump speeches with references to his opposition to embryonic stem (ES) cell research and abortion and his doubts about the role of humans in global warming. All those positions, plus a declaration that his Mormon faith would not dictate any decisions he might make as president, were aimed at wooing conservative Christian voters in the state.

That focus is a far cry from 5 years ago, when the 60-year-old businessman campaigned successfully to become governor of the high-tech state of Massachusetts. The new chief executive wowed biotechnology leaders and university administrators with his aggressive and no-nonsense talk about unleashing the power of research. “We were impressed by his willingness to talk about the importance of research universities in the state and national economies,” says Paul Parravano, co-director of government and community relations at the Massachusetts Institute of Technology (MIT) in Cambridge. “For a lot of people here, this was fresh and important.” As a venture capitalist with an MBA from Harvard University, Romney “understands the role of places like MIT and was very supportive,” says another university official.

During his first years as governor, researchers say, Romney talked the talk, co-chairing a national summit on innovation and telling the Massachusetts Biotechnology Council that “we want to make sure we are at absolutely the front edge” of stem cell research. He promised he would work to provide “the same kind of opportunities that you would find in any other state in America.” And he walked the walk. He launched an effort to lure more high-tech talent into the state and joined with seven other Northeastern states on a regional plan to reduce carbon dioxide emissions at power plants—the first collective U.S. effort to control greenhouse gases. He also consistently opposed efforts to introduce the teaching of intelligent design in the classroom.
His 2-year honeymoon with the research community ended abruptly in 2005, however, just as Romney’s presidential campaign was getting started. The governor abruptly backed out of the regional emissions plan, citing its cost to consumers. He vetoed a bill passed by the Massachusetts legislature to allow ES cell research, citing his ethical concerns. Research advocates say that they never were able to sit down with the governor to discuss the bill, which was a major concern for many industry and university biologists in the state. “We were never able to engage,” says one supporter who requested anonymity. “This was an eye opener; he was changing his stripes.”

Even so, one of the strongest advocates for science in Congress, Representative Vernor Ehlers (R–MI), calls Romney “the best choice for any scientist or engineer.” The former physicist and longtime member of the House Science Committee praises the candidate as bright and unburdened by ideology, noting that “he appreciates the benefits of science.” Ehlers, who knew Romney’s late father, a former governor of Michigan, says that he is heading up a science advisory committee for the candidate.

Ehlers told *Science* that he expects Romney’s list of priorities to include, in particular, increased funding for math and science education and, more generally, higher spending on research of all kinds. But he speculates that Romney “may choose not to be vocal” on global warming, although Ehlers himself supports sharp reductions in carbon dioxide emissions. In a July 2007 issue of *Foreign Affairs*, Romney calls for “a bold, far-reaching research initiative—an energy revolution—that will be our generation’s equivalent of the Manhattan Project or the mission to the moon.”

Some of Thompson’s recent positions have not endeared him to researchers. Within a few hours of reading about a method of genetically reprogramming skin cells into what appear to be embryoniclike stem cells, he rushed out a statement lauding the discovery. “Today’s announcement is just one more indication that our current policy in relying only on adult cells is working,” he said on 20 November. Thompson ranked the achievement as the latest addition in “73 breakthroughs for adult and cord blood research” that he said have paved the way for new treatments for several diseases.

That tally comes from the Family Research Council, a conservative advocacy group in Washington, D.C. Many scientists regard the analysis, by the council’s David Prentice, as seriously flawed, and even Prentice says the list did not imply that those breakthroughs had led to available treatments. “[The list] not only misrepresents existing adult stem cell treatments, but also frequently distorts the nature and content of the references he cites,” wrote Steven Teitelbaum, former president of the Federation of American Societies for Experimental Biology in Bethesda, Maryland, in a letter published in *Science* (28 July 2006, p. 439). “Fred Thompson is misinformed,” Teitelbaum says about the candidate’s latest pronouncement.

Thompson has also climbed out on a limb in discussing climate change. “While we don’t know for certain how or why climate change is occurring, it makes sense to take reasonable steps to reduce CO₂ emissions without harming our economy,” notes an issues statement from the campaign. In March, Thompson jokingly told a radio audience that “quite a few planets in our solar system seem to be heating up a bit. This has led some people, not necessarily scientists, to wonder if Mars and Jupiter, nonsignatories to the Kyoto Treaty, are actually inhabited by alien SUV-driving industrialists.”

Gavin Schmidt, a climate modeler at NASA’s Goddard Institute for Space Studies in New York City, calls the statement “ridiculous” and says it’s based on the faulty idea of a recent warming of the sun. “We’ve been measuring the sun’s temperature for 30 years—it’s not doing anything,” Schmidt notes.

Campaign staffers declined repeated requests from *Science* to detail Thompson’s views on science and technology issues. And last month, at an Iowa debate in which each Republican candidate was asked whether climate change was real and caused by human activities, Thompson chose to go for a punch line rather than inform his audience. First he declined to give a yes-or-no answer. Then, after one long-shot candidate gave a rambling response that seemed to ignore the question, Thompson passed again. “I agree with Alan Keyes’s position on climate change,” he cracked to wide laughter from the audience.

—ANDREW LAWLER
# Iowa and After

After months of manoeuvre and preliminary debate, on 3 January the Iowa caucuses mark the start of the formal process by which the US political parties will choose their presidential candidates. A host of issues are on the table, and science is not high on the list. Nevertheless some scientific issues are cropping up on the campaign trail.

Stem cells, although still an issue, seem to have taken a back seat, even though the new president would be in a position to repeal President George W. Bush’s 2001 restrictions on federal funding for research on embryonic stem-cell lines. Climate and energy receive a lot of attention, with candidates happy to talk of emissions reductions that would bite far after their terms have ended, and with some who have previously opposed corn-ethanol subsidies changing their minds when looking for votes among the Iowa cornfields. Spending on the physical sciences, other than energy, comes up rarely — although Senator Barack Obama’s proposal to take funds from NASA’s planned shuttle replacement has ruffled some feathers.

*Nature’s* Eric Hand takes a look at the leading candidates’ stances on some science-related issues.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Hillary Clinton (Democrat) Senator From New York, Former First Lady</th>
<th>Barack Obama (Democrat) Senator From Illinois</th>
<th>John Edwards (Democrat) Former Senator From North Carolina</th>
<th>Bill Richardson (Democrat) Governor Of New Mexico, Former Energy Secretary</th>
<th>Joe Biden (Democrat) Senator From Delaware</th>
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<tr>
<td><strong>Climate/energy</strong></td>
<td>Calls for reducing emissions by 80% from 1990 levels by 2050 via a cap-and-trade system. Does not support a carbon tax but argues for standards on efficiency, mileage, and renewable energy to meet that goal. Says she is &quot;agnostic&quot; about nuclear power.</td>
<td>Calls for reducing emissions by 80% from 1990 levels by 2050 via a cap-and-trade system. Wants to invest $150 billion over 10 years in alternative energy sources. Supports coal liquefaction, but only if it emits 20% less carbon than conventional fuels.</td>
<td>Calls for reducing emissions by 80% from 1990 levels by 2050 via a cap-and-trade system. Wants to push for a climate change treaty that has binding elements for all countries, including those in the developing world. Opposes nuclear power — says it’s too costly to build new plants and too unsafe to dispose of waste.</td>
<td>Calls for reducing emissions by 90% from 1990 levels by 2050 via a cap-and-trade system. Proposes increasing mileage standards to 50 miles per gallon by 2020, and setting a renewable-energy target of 30% by 2040.</td>
<td>Calls for reducing emissions by 80% from 1990 levels by 2050. Wants every US car sold to be equipped with flex-fuel technology, and half of all major gas stations to offer biofuels by 2017. Supports ethanol from corn as a transitional solution for energy woes, but says it is not sustainable in the long term and pushes for cellulosic sources.</td>
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<td><strong>Biomedical/stem cells</strong></td>
<td>Supports federal funding for embryonic stem-cell research. Proposed increasing National Institutes of Health budget by 50% over five years, and doubling it over ten years.</td>
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<td><strong>Space</strong></td>
<td>Supports human exploration of space, including completing the International Space Station and replacing the space shuttle with a new generation of launch vehicles.</td>
<td>Would delay NASA’s Constellation programme to build new rockets and crew vehicles for five years, instead putting that money toward an $18-billion education plan.</td>
<td>Supports human exploration of space, and says other countries should also be involved.</td>
<td>Sees space as a &quot;bona fide area of economic growth and opportunity&quot;. Pushed for a sales tax to support the building of a spaceport in New Mexico.</td>
<td>Wants to make China a full partner in space exploration rather than a &quot;frustrated new entrant&quot; that has to catch up with the United States.</td>
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<td><strong>Notable quote</strong></td>
<td>“My 5th grade teacher Mrs Kraus came into our classroom and said we had to study math and science because the President said so. I was convinced that President Eisenhower had called up Mrs Kraus and told her, ‘You tell those children — and particularly that Hillary, who doesn’t really like math — that her country needs her.’”</td>
<td>“We’re not going to have the engineers and scientists to continue space exploration if we don’t have kids who are able to read, write and compute.”</td>
<td>“Colleges are the places where we ensure that America is competitive. Yet we’ve taken away funding for the NIH and our research universities. That’s just a mistake.”</td>
<td>“I myself have been told that I have a lot of energy. The secret is that I use renewable resources. Some days I’m solar powered. Some days I’m wind powered. And some days my critics just think I’m full of compressed air.”</td>
<td>“For too long we have abdicated the responsibility to reduce our own emissions.”</td>
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See Editorial, page 1.

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Calls for reducing emissions by 80% from 1990 levels by 2050, potentially via a carbon tax. Proposes a Works Green Administration that would retrofit buildings with wind and solar power. Wants to halt all mining and logging on public land.

Supports federal funding for embryonic stem-cell research. “There are so many different things that stem-cell research can teach us.”

Wants NASA to focus “more on earthly projects” such as producing green energy. Says innovations will “eventually” be turned into space exploration.

On reports that he had seen a UFO: “More people in this country have seen UFOs than I think approve of George Bush’s presidency.”

“Nuclear power is dangerous. So is every form of power. But no one’s died from nuclear power in the United States. So our commitment here is to expand it, make sure it’s safe.”

Wants to halt all drilling and logging and see a plan to address global warming, but says he opposed the Kyoto Treaty, are “simply an acknowledgement that you can pollute with government permission”. Supports expanding nuclear energy. Opposes tariffs on ethanol from corn.

On global warming: says there are “reputable scientists on both sides of that argument”. Opposes major government regulations to control emissions. Does not support a carbon tax, which he calls “simply an acknowledgement that you can pollute with government permission”. Supports expanding nuclear energy. Opposes tariffs on ethanol from corn.
In the news

**SCANNING POLITICS**

The *New York Times* recently published an Op-Ed article written by a group of neuroscientists, neuromarketing researchers and a public policy expert. It described how the brains of 20 swing voters in the USA responded (as measured by functional MRI) to pictures of, and speeches by, US presidential candidates (*New York Times*, 11 November 2007).

A number of eminent cognitive neuroscientists wrote in response that they were "distressed by the publication of research in the press that has not undergone peer review, and that uses flawed reasoning to draw unfounded conclusions about topics as important as the presidential election." (*New York Times*, 14 November 2007).

Writing in the Neuroethics and Law Blog, Marta Farah of the University of Pennsylvania, USA, commented that "the idea that functional brain images are more susceptible to fakery than many other kinds of scientific evidence is debatable." (http://kolber.typepad.com/ethics_law_blog/2007/11/this-is-your-br.html) Nevertheless, Farah was skeptical about the data because they were not validated; interpreting such data might result in 'just so' stories. Moreover, a study that uses brain imaging might be perceived by the general public as "more 'scientific' and perhaps even more 'objective'" than studies using, for example, questionnaires, neither of which is necessarily the case. (http://kolber.typepad.com, 12 November 2007)

Ben Goldacre agreed in his blog on the *Guardian* website: "...it's tempting to over-extrapolate, selling activation locations as supporting your favoured hypothesis, while ignoring all kinds of alternative interpretations." (*Guardian*, 17 November 2007).

Political campaigners might find the *New York Times* article useful and use the findings to fine-tune their strategies. However, until the findings have been published in a peer-reviewed journal, it seems that the best way to find out which candidate voters prefer is by counting ballots.

Leonie Welberg
November 11, 2007

OP-ED CONTRIBUTORS

This Is Your Brain on Politics

This article was written by Marco Iacoboni, Joshua Freedman and Jonas Kaplan of the University of California, Los Angeles, Semel Institute for Neuroscience; Kathleen Hall Jamieson of the Annenberg Public Policy Center at the University of Pennsylvania; and Tom Freedman, Bill Knapp and Kathryn Fitzgerald of FKF Applied Research.

IN anticipation of the 2008 presidential election, we used functional magnetic resonance imaging to watch the brains of a group of swing voters as they responded to the leading presidential candidates. Our results reveal some voter impressions on which this election may well turn.

Our 20 subjects — registered voters who stated that they were open to choosing a candidate from either party next November — included 10 men and 10 women. In late summer, we asked them to answer a list of questions about their political preferences, then observed their brain activity for nearly an hour in the scanner at the Ahmanson Lovelace Brain Mapping Center at the University of California, Los Angeles. Afterward, each subject filled out a second questionnaire.

While in the scanner, the subjects viewed political pictures through a pair of special goggles; first a series of still photos of each candidate was presented in random order, then video excerpts from speeches. Then we showed them the set of still photos again. On the before and after questionnaires, subjects were asked to rate the candidates on the kind of 0-10 thermometer scale frequently used in polling, ranging from “very unfavorable” to “very favorable.”

We then compared the questionnaire responses with the brain data, and here’s what we found:

1. Voters sense both peril and promise in party brands. When we showed subjects the words “Democrat,” “Republican” and “independent,” they exhibited high levels of activity in the part of the brain called the amygdala, indicating anxiety. The two areas in the brain associated with anxiety and disgust — the amygdala and the insula — were especially active when men viewed “Republican.” But all three labels also elicited some activity in the brain area associated with reward, the ventral striatum, as well as other regions related to desire and feeling connected. There was only one exception: men showed little response, positive or negative, when viewing “independent.”

2. Emotions about Hillary Clinton are mixed. Voters who rated Mrs. Clinton unfavorably on their questionnaire appeared not entirely comfortable with their assessment. When viewing images of her, these voters exhibited significant activity in the anterior cingulate cortex, an emotional center of the brain that is aroused when a person feels compelled to act in two different ways but must choose one. It looked as if they were battling unacknowledged impulses to like Mrs. Clinton.
Subjects who rated her more favorably, in contrast, showed very little activity in this brain area when they viewed pictures of her.

This phenomenon, not found for any other candidate, suggests that Mrs. Clinton may be able to gather support from some swing voters who oppose her if she manages to soften their negative responses to her. But she may be vulnerable to attacks that seek to reinforce those negative associations.

3. Hillary Clinton and Rudy Giuliani are on opposite sides of the gender divide. We found indications that Mrs. Clinton and Mr. Giuliani represent two sides of the same coin: Men show little interest in Mrs. Clinton initially but after watching her video they react positively. Women respond to her strongly at first, but their interest wanes after they watch her video.

With Mr. Giuliani, the reactions are reversed. Men respond strongly to his initial still photos, but this fades after they see his video. Women grow more engaged after watching his video.

This is evidence that swing voters’ responses change when they see these two candidates in action. For men, Mrs. Clinton is a pleasant surprise. For women, Mr. Giuliani has unexpected appeal.

4. The gender gap may be closing. In recent presidential elections, Democrats have done better with female voters, while Republicans have appealed more to men. So far this time, male swing voters seem to be looking more closely at the Democrats. After viewing all the candidate videos, our male subjects, when viewing still photos of the Democrats, showed significantly higher activity in the medial orbital prefrontal cortex, an area that is activated by rewarding stimuli, than they did while looking at pictures of the Republicans.

Women did not display such a one-party skew, but rather tended to react to individual candidates. So the traditional gender pattern of party preference may not be as prominent this year, particularly among men, and that may be good news for Democrats.

5. Mitt Romney shows potential. Of all the candidates’ speech excerpts, Mr. Romney’s sparked the greatest amount of brain activity, especially among the men we observed. His still photos prompted a significant amount of activity in the amygdala, indicating voter anxiety, but when the subjects saw him and heard his video, their anxiety died down. Perhaps voters will become more comfortable with Mr. Romney as they see more of him.

6. In Rudy Giuliani versus Fred Thompson, the latter evokes more empathy. There is much discussion this year about “authenticity,” as politicians strive to be credible and real. On this front, Mr. Thompson may have an advantage over Mr. Giuliani. When our subjects viewed photos of Mr. Thompson, we saw activity in the superior temporal sulcus and the inferior frontal cortex, both areas involved in empathy. When subjects viewed photos of Mr. Giuliani, these areas were relatively quiet.

Our subjects also exhibited a much stronger empathetic response to a minute-long excerpt from a stump speech by Mr. Thompson than they did to an excerpt of a Giuliani speech. This
connectedness toward Mr. Thompson did not show up in the swing voters’ answers on the questionnaires, but it suggests that if swing voters see more of both candidates, Mr. Thompson may gain an advantage over Mr. Giuliani.

7. John Edwards has promise — and a problem. When looking at pictures of Mr. Edwards, subjects who had rated him low on the thermometer scale showed activity in the insula, an area associated with disgust and other negative feelings. This suggests that swing voters’ negative emotions toward Mr. Edwards can be quite powerful.

The good news for Mr. Edwards is that the swing voters who did not give him low ratings, when looking at still photos of him, showed significant activation in areas of the brain containing mirror neurons — cells that are activated when people feel empathy. And that suggests these voters feel some connection to him. So Mr. Edwards has a strong effect on swing voters — both those who like him and those who don’t.

8. Barack Obama and John McCain have work to do. The scans taken while subjects viewed the first set of photos and the videos of Mr. McCain and Mr. Obama indicated a notable lack of any powerful reactions, positive or negative. The male subjects showed some interest in Mr. McCain while looking at still photos, but their engagement fell off after they watched him on videotape. Women remained unengaged throughout the session.

Mr. Obama was rated relatively high on the pre-scan questionnaire, yet both men and women exhibited less brain activity while viewing the pre-video set of still pictures of Mr. Obama than they did while looking at any of the other candidates. Among the male subjects, the video of Mr. Obama provoked increased activity in some regions of the brain associated with positive feeling, but in women it elicited little change.

Our findings suggest that Mr. Obama has yet to create an impression on some swing voters. While his speech resonated with the men in our study, it failed to engage the women. Since we did our scans, Mr. Obama has altered his tone somewhat, and it will be interesting to see if that makes a difference.