This morning I want to discuss with you the way in which our society deals with complex issues like energy and climate change, or medical services, or military technology. Not only have such issues become much more complex than they were, say 30 years ago, but the roles and performance of the players who make decisions about what to do in such cases have become more complex too.

The three main players are government officials and politicians, technical and other experts, and of course the voting public. In addition there are two other groups, who pretend to be on the sidelines – the media which tell us what we should think and the lobbyists who tell members of Congress how to vote. Of these five groups, the one that is most important, and appears to be least influential, is the voting public. Let’s start with an example.

Last week the President and the Congress gave up on one of Obama’s top priorities from his campaign – the passage of a comprehensive bill to ameliorate the worst hazards of global climate change. Lee Wasserman, in an Op-Ed in the New York Times, explained their failure on “lack of support from those most responsible for the problem.” I shall paraphrase how he enumerated the following “Four Ways to Kill a Climate Bill.”

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1 This talk is drawn substantially from L. M. Branscomb “Science as a Model for Rational, Legitimate Government Capable of Meeting Society’s Grand Challenges” Physics and Society 38, No. 4, Oct. 2009, and an address at the annual meeting of the AAAS in San Diego on Feb. 19, 2010. A brief summary of these ideas was published in The Chronicles of the UCSD Emeriti Association for April 2010. I also apologize for failing to realize that a four legged stool can be wobbly, but not a 3-legged one. Shame on me.
1) Since the economy is most pressing in the public’s mind, and climate is a complicated and long range issue, the administration made little effort to explain the urgency of climate change to the public.

2) The conventional wisdom of the Beltway lobbyists is that you must first persuade the industry that most contributes to climate change that it must accept an effective but costly legislative program.

3) This meant that Congress would create a bill crammed with complex policy provisions to satisfy each affected industry. The bill Congress actually developed contained pollution allowances for favored industries, and international provisions that would avoid having to reduce greenhouse gas emissions here at home. The bill also included carbon credit default swaps. Campbell Soup even demanded “a special deal for the carbon-intensive job of making chicken noodle soup.”

4) Fourth was the basic source of the government’s failure to address the problem seriously: Wasserman’s heading: “The Public Sits it Out.”

Let me quote Wasserman:

“American history has few examples of Presidents or Congresses upending entrenched interests without public pressure forcing their hand. Teddy Roosevelt is on Mount Rushmore for a reason. Citizens wouldn’t support an approach they couldn’t understand, to solve a problem our leaders refused to acknowledge. Even the earth’s flagging ability to support life as we know it couldn’t stir a public outcry. The loudest voices insisted that leaders in Washington do nothing. They obliged.”

But how well informed is that public that sat out the political debate over climate change legislation?

*The Public Agenda*, a non-profit research organization founded in 1975 by Daniel Yankelovich and Cyrus Vance, has been studying what the public knows and thinks about energy and climate policy.
Their study was described by *Public Agenda* Sr. VP Jean Johnson at the annual AAAS meeting in San Diego last February. She and Dan both argued that the conventional idea that we only need an “informed public” to get good policies is deceptive. In the case of climate, for example, experts, with the aid of media, have been telling the public for a long time about the urgency of climate change and the dangers of energy import dependence. Thirty years ago, in 1979, the best science authority in the country, the National Academy of Sciences, reported that global warming was highly credible. Every year since, there have been important voices telling the public this is a serious issue. Remember the Kyoto Protocol, the first IPCC report in 1990, Al Gore’s movie and Nobel prize, and last year EPA found carbon emissions in the atmosphere hazardous under the Clean Air Act.

Despite all this public information, 4 in 10 Americans cannot even name a fossil fuel. 6 in 10 cannot name a renewable energy source. Fifty-six percent believe nuclear energy causes global warming. Thirty-two percent even believe solar energy causes global warming.

And despite all this public information, the message sent is not the message received. Science is telling us that climate change is one of the greatest threats facing humanity. What the public hears is increases in gas prices. Dependence on foreign oil worries 60% of Americans, while only 32% worry about global warming.

Some key information has been absorbed. The majority of Americans recognize that driving cars does contribute a lot to global warming. An even larger percentage recognizes that dependence on foreign oil is an economic issue and could result in higher oil prices. But the public is still thinking wishfully and rejects many of the warnings of key experts. They like to blame oil prices on speculators and believe the US has more than 10% of world oil reserves (really it is 2.4%).
Could it be, then, that lack of understanding of the most basic relevant technical facts is at least in part responsible for public unwillingness to accept any policy that increases the cost of driving? The public worries about gas prices even though nearly seven in 10 say they want the nation to “take steps to gain energy independence even if it raises costs?” Perhaps they are thinking about someone else’s costs when they answered that question.

The scientific community holds itself somewhat responsible for the public’s lack of comprehension of the well-established facts underlying sensible public policies. We scientists tend to believe that rational government depends on the scientists’ ability to give good advice to the politicians. If the politicians don’t accept our advice, we blame them. We don’t blame the public for not convincing politicians that our science advice should be listened to. Or, some of us hope that supporting well-intentioned programs of “public science literacy” or “public understanding of science” will somehow make up for the public’s ability to understand the trade-offs between short term costs and long term benefits of important policy issues.

Science cannot rely on telling the public what we think they need to know about math, physics, chemistry and biology, much less how we think they should vote. Indeed Dan Yankelovich and Jean Johnson agree that providing information to the public – telling them the facts, so to speak -- is not the answer either. They argue that scientist must be explainers, not teachers, and not advocates. They see that the path to more sophisticated voters is not more information but is a process of public opinion making that is complex, time consuming, and incorporates many elements other than exposure to facts.

Dan describes this process as involving three stages of development, which may take months or years, even decades. The first stage is consciousness raising, where the media have an important role. The second stage he calls “working through”. Here leadership and choices are essential. The third stage is resolution of conflicting view, where the political system must come to a conclusion. Yankelovich and Johnson call these three steps the “Public’s Learning Curve” in contrast to the static image of an “informed public.”
The most time consuming and difficult of the three stages is the second, or “working through” stage. This stage is the least compatible with American culture. Here information is, of course, necessary, but the public is also engaged with values-based choices, wishful thinking, questions of who is included in the process and whom to believe. In addition, the public must cope with distractions, with denial, and lack of background and context. Dealing with statistical likelihood and other technical concepts is often difficult. And when the scientists disagree among themselves, the public becomes disoriented.

Given the sad state of public education in science and mathematics, the technical community and government must become more skilled at explaining those elements of scientific knowledge that are relevant to addressing the issues the public cares about. And when discussing policy issues such as energy and climate change, both scientists and politicians must understand how the public goes about making up its collective mind. This is very important. But even more important is the goal of competent governance and good policy decisions. The stability and sound functioning of our democracy is at stake.

The Constitution was designed on a set of assumptions about how the people would ensure wise governance in the absence of a monarch or autocrat running the country. In short the people must be able to govern themselves. The expectations of the Constitution’s authors have seriously eroded over the years, and especially in the last decade.

Let’s go back and take a quick look at that history. We need to understand the extent to which the rational behavior of our government does, indeed, depend on the role that science played in the thinking of the “founding fathers.” Their concern was how their new political invention would shield the people from autocracy and become legitimate and effective in the eyes of the voters. That is why they built checks and balances into the tripartite structure of the government.
Both American democracy and modern science are products of the Enlightenment, with its emphasis on reason and openness, rather than on religious and political authority.\textsuperscript{2} The Founders constructed an arranged marriage between two partners -- rational citizens and politicians – who would be dependent on one another, but for motives that are quite different and to some degree conflicting. For rational citizens, educated during the Enlightenment, their model was the extraordinary achievements of 18\textsuperscript{th} century science and philosophy. American democracy has always benefited from a pragmatic willingness to learn from experience, very much as science relies on experiment.

Progress in science is based on transparency, accountability, and trust. These are also basic principles of sustainable democratic government. Thus if science and democracy are both to flourish, government must be pragmatic, open, and viewed by the voters as legitimate and responsive to voter desires. If science is corrupted by government, government itself is in danger of becoming corrupt. And conversely, when government allows itself to become corrupt, science advice is sure to suffer as well.

Ensuring that not only our science, but also our politicians are transparent in their government work, accountable for the consequences of their decisions, and trustworthy in what they say and do, requires more concerted effort than the Founders ever thought might be required.

Authors of the Constitution could not have anticipated the inevitability of universal suffrage. In their day, the voters were propertied, white men like themselves -- a small, mostly well-educated, elite fraction of the population. The electorate today is not only comprised of all the nation’s citizenry, but these voters learn about issues and make decisions in the more diffuse way that Yankelovich and Johnson describe.

In our democracy, the relationship between science and politics has never been easy, but in the minds of the drafters of the Constitution, it was always important. The search for truth in science and for legitimacy in politics both require systems for generating trust, but these systems are not the same. Indeed, as already noted, they are often incompatible. The most profound area of mismatch between science and politics comes down to the conflict between rational political judgments based on facts established by professional scientists, economists and other experts, and political interests communicated to the politicians by lobbyists and by their own roots and ideologies. The financial support from lobbyists seems often a more effective way to assure their re-election than the confidence of the voting constituents in their good judgment.³

Both democracy and science stand to benefit enormously when our political leaders understand that the traditions of science and the mechanics of democracy have common roots.

If the voters are ignorant of the relevant technical issues, how can they evaluate the performance of government officials? And if they cannot judge the politicians’ performance intelligently, how can they establish the legitimacy of their governance? If public attitudes are not founded on sound knowledge, but are only guided by their values, belief systems, world views and emotions, those beliefs will guide their views. Lobbyists and their sponsors will then find it easier to leverage those public attitudes by distorting the facts. Their interests, as we see too often, may carry the day. Science must, therefore, not only give wise advice to government, but must also find a way to share with the public their understanding of the factual basis for policy choices.

Thus if we are to preserve the legitimate and accountable system of government envisioned by the authors of the Constitution, and enjoy the fruits of an intelligent, informed society, government must be responsive to a sophisticated voting public, and

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³ I use “lobbyist” to mean those whose sponsors provide generous funds with which to influence politicians by supporting their re-elections. I distinguish them from the many advocates who represent organizations, usually not-for-profits, who are not in a position to contribute funds to politicians.
science (and the media) must more effectively share with the public what they know and how they know it.

In short, our original system of governance, in which the legitimacy of government depended on a small, elite of voters, is slowly but steadily morphing into a dysfunctional democracy, in which the full span of eligible voters is insufficiently well informed and motivated to hold those who govern to the requirements of transparency, trust and effectiveness.

In recent years, we seemed to have been going down that treacherous path. During the 2008 political campaign, presidential-candidate Obama promised to reverse that trend. Many political observers of the campaign, including Dan Yankelovich, spoke often of “new pragmatism” as Obama’s guiding principle for governance. As President, Obama got off to a very good start, having appointed exceptionally well-qualified scientists to top posts in his government, promising to make decisions based on the best expert assessment of relevant facts. His governance was to be rational, pragmatic, and transparent.

He has not found this promise easy to fulfill.

Thus, sound policy and accountable democratic governance depends on a triangle comprised of political institutions, the community of experts, and the voting public. *This is the wobbly, three-legged stool.* The scientists’ mistrust of politicians is reciprocated. The politicians, aware than the public is easily confused by technical arguments, fall back on their ideological biases and their sources of campaign funds. Instead of relying on the public’s trust, earned by their demonstration of transparent governance and effective decisions, they increasingly rely on the money and influence of lobbyists who represent an economic and power elite, and who do not see themselves accountable to the public.
The public has a lower regard for the Congress than they do for used car salesmen. That leg of the triangle is wobbly enough. But the scientists’ engagement with the voting public leg of that triangle is particularly weak, despite many well intended efforts. That role – preparing the public for judging the performance of those who govern them -- has been largely left to a fourth player, the media.

How well do the media help the public learn what they need to know from science and how to use that knowledge to expand the quality of political governance? As Dan Yankelovich points out, media may do a reasonable job of “consciousness-raising” about what the public issues and are eager to cover the final disputes over what outcomes may result. But the second stage, “working through those issues,” is where most of the media fall short. This is the stage where sorting out the facts and the evidence they rest on, is most important. Thus there are weaknesses in all three legs of the wobbly triangle. The media do not adequately compensate for the weakness in the relations between science and the public or between science and politics.

Indeed, the media are increasingly merged into conglomerate business enterprises or fragmented into ideologically specialized TV channels or Internet blogs. Some, like our best newspapers, are losing their markets or, like Fox News, have abandoned their commitment to the traditional ethics of independent journalism.

If the politicians, the experts, and the voters no longer trust each other or the media, and if political power is shifting to the moneyed special interests, it should be no surprise that political compromise, so necessary to get anything done, has become early impossible. I would like to share with you some data that may convince you of the seriousness of this trend.

James A. Thompson, President of the Rand Corporation – the nation’s premier think-tank – prepared a most interesting paper entitled “A House Divided.” Let me show you just three slides that may shock you. These slides use a complex political science methodology that I shall not try to explain in detail. Suffice it to say that the authors
looked at over 100,000 role-call votes in the US Congress and tested the consistency over the last 35 years of voting by individual members on issues that seemed to best correlate with liberal or conservative ideology.

Figure 1

The first figure shows how Democrats (blue) and Republicans (red) differed in votes related to economic policy – the most consistent index. The vertical axis indicates the strength of an individual congressman’s liberal or conservative ideology. The horizontal axis measures the consistency of that view as reflected in each individual’s voting pattern.

As you see from the 1973 data, there is a clear distinction between the views of most most Republicans and most Democrats – no surprise. But there was also a substantial overlap of ideology – Republicans who voted for more liberal policies than many Democrats, and *vice versa.*
Now look at 2003 – 30 years later. One democrat and one republican appeared to have similar economic ideology, as reflected in their voting patterns. The liberal Republican was Jim Leach of Iowa who was defeated in 2006. The conservative Democrat was Ralph Hall of Texas, who switched parties. This leaves each political group completely trapped into its own group’s ideology.

As Senator Lindsey Graham put it, “You are one team versus the other and never shall the twain meet. If it’s a Democratic idea, I have to be against it because it came from a Democrat. And vice versa.”
Figure 3, above, shows the distribution of congressional democrats and republicans in three sessions of Congress, separated by two decades each, starting in 1967, 1987, and 2007.

Elective politics must be reformed to permit a more rational process for the public’s evaluation and approval of political positions and actions. Key is weakening the dependence of politics on money. Unfortunately, the Supreme Court has just made this task much more difficult by allowing unlimited amounts of money from companies, unions and other organizations to flow into political advertising in behalf of candidates.
As one commentator predicted, the winner of the 2010 mid-term election will be neither the Democrats, nor the Republicans; it will be the moneyed interests.

Reform of the political process is easy to design, but it is hard to see how two parties unable to work together can be induced to enact the needed changes. The public will have to demand it. The best indication of how hard this will be is the failure of the Disclosure Bill that would have placed no restrictions on corporate or union expenditures but would require donors of expenditures over $600 to identify themselves. No Republicans in the Senate voted for it and the bill failed for lack of a cloture vote.

This gets us back to how the voting public can be helped in their need to demand reform in our politics.

Scientists, engineers and other experts must be trained and motivated to communicate with the voting public about issues the voters care about. For this to happen, many more scientists and engineers must themselves become educated about public policy, so their communication with the public can be in the context of voters’ real concerns.

Our professional institutions are a major asset in this effort; many of them, especially the Academies of Science and Engineering, the Institute of Medicine and the AAAS are devoted to informing decision makers about the science-based facts that matters in policy. The divisions between the political parties make this path of limited effectiveness. However, this third leg of the wobbly stool calls for a stronger relationship with the voting public.

Dan Yankelovich, in his presentation to the AAAS last February, presented 6 pieces of advice to those in the scientific community who want to make a contribution to building a more functional society in an increasingly complex world:

1) **Tracking studies**: Map the public’s progress through the three stages.

2) **Anticipate resistance**: Identify the likely obstacles and how to overcome them.
3) **Legitimacy**: Accept the public’s learning curve process as a legitimate way of knowing, even though it differs radically from the scientific conception of knowledge.

4) **Learn a new skill**: Learn to translate scientific information into value-based choices to fit the public’s learning curve framework.

5) **Avoid spin**: Leave selling of any one choice to political leadership

6) **Seek validation**: Initiate efforts to validate and elaborate the learning curve hypothesis.

The task seems daunting but one can at least list a few of the main challenges. But this challenge is especially important for our research universities, both as an opportunity and, I believe, an obligation.

In addition to all the complexities within each of the three legs of the wobbly stool of democratic governance, there is the addition turmoil within the institutions and technologies for creating and communication information in this country.

The internet has greatly augmented the traditional channels of public information, and most important, has added diversity to views reaching both the media and the public. Social networks reach a broad spectrum of citizens not previously so accessible to the professional community. Blogs, interest groups, and ever-more sophisticated search engines provide opportunities for individual scientists to communicate to a broader audience. Through these and related digital services individuals and professional societies and other non-profit institutions can offer both technical and policy expertise. From a longer term prospective, the colleges and universities can be most helpful, although they too give inadequate attention to public policy and the science knowledge required to make wise public choices. Unfortunately we already see vested interests that dominate our polarized government launching campaigns to discredit science in the public eye.
The best example is the backlash on climate change built on exploiting the controversy over the emails from a staff member of the climate research group at East Anglia University in England. Detailed investigations by the Royal Society of London and others refuted accusations of doubting the reality of the climate change threat. But there is already a discernable loss of trust in science on the part of the American public. President Cicerone of the National Academy of Science is openly concerned about the consequences of what is now emerging as organized attacks on the credibility of our best science.

What is the prospect for building a stronger, more rational society? Here is my list of problems we face:

- polarization of the Congress, the
- dominance of money from lobbyists and special interests, the
- complexities of many of the issues facing the nation, the
- lack of experience among scientists in public policy and how the voters think, the
- emerging attacks on the credibility of science from moneyed interests who challenge the role of science in public policy
- complexity of the “Public Learning Curve” and the need to understand it, and the
- public’s inability call the political system to account?

These challenges – to scientists and other professionals – are not new to our nation’s best leaders. I pointed to President Obama’s commitment to pragmatic government whose policies would rest on well grounded facts. His predecessor 52 years ago, President Dwight Eisenhower, faced similar complexities, leading our democracy during the Cold War with the Soviet Union. He replied to a veteran who was seeking what Ike called “freedom from the mental stress and burden of democracy” with these words:4

“It is difficult indeed to maintain a reasoned and accurately informed understanding of our defense situation on the part of our citizens, when many prominent officials,

possessing no standing or expertness as they themselves claim it, attempt to further their own ideas or interests by resorting to statements more distinguished by stridency than by accuracy.”

Americans must turn back to the basic ideas of the Enlightenment, seeking a governance system that is more rational, pragmatic, and responsible to the electorate. The elite specialists and experts must also earn the trust of the public and in turn provide voters with information that is not only reliable but is relevant to the voters concerns and the way they make decisions on public issues. The politicians must listen more to their constituents, and less to the lobbyists. Will they do this? They will if constituents are better informed and hold their representatives in government to account. Their legitimacy must, like science, rest on transparency, effectiveness and trust as assessed by a more committed and better educated public.

ii United Nations’ International Panel on Climate Change (IPCC).
iii American Association for the Advancement of Science (AAAS)