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SOCIAL AND ETHICAL IMPLICATIONS IN NANOTECHNOLOGY LEGISLATION DEBATED

On May 7, the House of Representatives, by voice vote, passed H.R. 766, the Nanotechnology Research and Development Act of 2003. The legislation authorizes \$2.36 billion over three years for nanotechnology research and development programs at the National Science Foundation (NSF), the Department of Energy, the Department of Commerce, NASA, and the Environmental Protection Agency. The bill provides a formal structure for coordination of research across the agencies, emphasizes interdisciplinary research, addresses societal concerns raised by nanotechnology, and requires outside reviews of the program.

The House passage followed a markup of the bill by the House Science Committee on May 1. Despite calls at an April 9 hearing to set aside a specific percentage for research on the social and ethical implications of nanotechnology and the precedent set by the National Human Genome Research Initiative (see *Update*, April 14, 2003), the Committee rejected an amendment sponsored by Reps. Brad Sherman (D-CA) and Chris Bell (D-TX) for a 5 percent set-aside. The bill still includes language "establishing a research program to identify social and ethical concerns related to nanotechnology, and ensuring that the results of such research are widely disseminated." Sherman was successful in adding language to the bill clarifying that research on societal and ethical concerns includes study of environmental implications, and the implications of possible development of non-human intelligence.

Sens. George Allen (R-VA) and Ron Wyden (D-OR) have introduced a companion bill, S. 189, in the Senate. The legislation includes numerous references to the
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NIH INSTITUTE AND CENTER DIRECTORS TESTIFY TO SENATE APPROPRIATIONS SUBCOMMITTEE

On April 8, National Institutes of Health (NIH) Director Elias Zerhouni, accompanied by the directors of the 27 NIH Institutes and Centers (ICs), appeared before the Senate Labor, Health and Human Services, Education Appropriations Subcommittee. The following is a sampling of Institute directors' written testimony highlighting the increased focus of NIH on social and behavioral science research:

Office of Behavioral and Social Sciences Research (OBSSR) – According to NIH Deputy Director Raynard Kington, testifying on behalf of the Office, "many exciting scientific developments are occurring at the intersection of behavioral and social science and biomedical research." Kington explained that OBSSR and several of the ICs are in the
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importance of examining the social and ethical implications of this new technology. It establishes, at the NSF, a Center for Societal, Ethical, Educational, Legal and Workforce Issues Related to Nanotechnology. The authorized funding is \$5 million, less than one percent of the \$678 million authorized in the bill for FY 2004. During the House consideration of H.R. 766, Rep. Sheila Jackson Lee (D-TX) offered and then withdrew an amendment to put such a Center in the House bill. House Science Committee Chairman Rep. Sherwood Boehlert (R-NY) argued that establishing one specific center would narrow the opportunities for research on social and ethical implications.

At a hearing before the Senate Commerce, Science, and Transportation Committee on May 1, Professor Davis Baird, Chair of the Philosophy Department at the University of South Carolina, endorsed the Center idea, although he suggested perhaps more than one would be necessary. He argued: "Such centralization is needed for the societal and ethical voice to be heard above the roar of the scientific and technological excitement."

The Senate bill is expected to pass and then will have to be reconciled with the House version in a conference committee.

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process of developing new approaches to train experts to undertake a program of research that extends well beyond traditional disciplinary boundaries.

Kington cited as an example a new postdoctoral program that would provide individuals trained in one discipline with formal course work and hands-on training in a second field. The initiative will serve as a way to train investigators to work in interdisciplinary teams that will allow tackling of some of the most pressing health problems.

OBSSR is also developing an initiative to encourage investigators to expand on current theoretical base of change processes and intervention models. This will further our understanding of how change, once achieved, is maintained over the long term, he informed the Subcommittee.

National Institute of Mental Health (NIMH) – Director Thomas Insel observed that "despite our research progress, our society faces a pressing need to strengthen the quality and accessibility of clinical services for mental

disorders for all those who require such services." According to Insel, in keeping with the Institute's mission the agency has assigned a high priority to moving information gained through research into the hands of providers, systems, patients, and families.

Discussing the psychological impact of terrorism, Insel explained that over the decades NIMH-supported behavioral science research has informed us about many basic behavioral mechanisms, including those influencing group processes. A key finding of this research to date is that people are very resilient. He stated that the vast majority of victims of mass disaster and terrorist attacks do not develop psychiatric disorders. But of those who do, the most frequent adverse outcome is post-traumatic stress disorder (PTSD). Through research, we are gaining an increasingly clear understanding of what variety of psychological and behavioral problems to expect in the event of an attack and the type of services that will be needed, Insel told the Subcommittee.

National Human Genome Research Institute (NHGRI) – Director Francis Collins informed the members that "due in great part to the visionary leadership and commitment of Congress," the International Human Genome Project (HGP), led by NHGRI, has accomplished all of its original goals, ahead of schedule and under budget.

Collins also noted that the Institute is planning to publish its "bold vision for the future of genomics research, which has three major focuses: Genomics to Biology, Genomics to Health, and Genomics to Society. (See *Update*, March 31, 2003). Collins observed that the completion of the human genome sequence offers a unique opportunity to understand the role of genetic factors in health and disease, and to apply that understanding rapidly to prevention, diagnosis, and treatment. He also observed that "just as HGP has spawned new areas of research in basic biology and health, it has created new opportunities in exploring societal issues." These opportunities include: analysis of the impact of genomics on concepts of race, ethnicity, kinship, individual and group identity, health, disease, and "normality" for traits and behaviors, and defining policy options regarding the use of genomics information in both medical and non-medical settings.

According to Collins, the NHGRI recognizes the critical importance of ensuring that the potential of genomic research benefits all racial and ethnic groups. He emphasized that "the significant societal ramifications of this research also need attention." Using resources designated for research on the Ethical,

Legal, and Social Implications (ELSI) of the HGP, the Institute has intensified its efforts to address health disparities by developing a strategic plan that identifies goals in areas such as research projects, information sharing, development of partnerships, and increasing diversity of the research workforce.

John E. Fogarty International Center for Advanced Study in the Health Sciences (FIC) – The research and training supported by FIC is “a window to a brighter future for low- and middle- income countries with heavy burdens of disease,” asserted FIC Director Gerald Keusch. He informed the Subcommittee that while people in these countries typically suffer from high infant, child, and maternal mortality rates, amplified manifold by the threats represented by AIDS, TB, malaria, and other seemingly intractable infectious diseases, these populations are now increasingly subject to the ravages of chronic disease and premature mortality represented by cardiovascular disease, diabetes, and cancer.

The Center supports research to better understand the impact of improving health on economic development, political and social stability, and active participation in the global marketplace. Because economic growth invariably impacts environment, explained Keusch, FIC has developed a research agenda to improve our understanding of the impacts on population health and individual well being related to sustainable economic development. He emphasized that these programs are crucial as we identify health care interventions that can improve both health and development.

The Center director also observed that gender and global health research is a previously neglected area. Not only may risk factors, disease progression, and response to treatment vary by gender, but societal responses based on gender may exclude women from accessing health care or may label them with stigma that adds significantly to the burden of disease.

Finally, Keusch noted that there is a growing recognition that the global burden of disease will increasingly include non-communicable diseases. The FIC’s current programs in this area address the burden of mental illness, the broad range of brain disorders across the life cycle, and the major epidemic of tobacco use and the inevitable epidemic of chronic pulmonary, cardiovascular disease, and cancer that will follow. The Center intends to explore ways to also address the huge and growing burden of morbidity and mortality due to trauma and injury, whether intentional or unintentional.

National Institute on Aging (NIA) – Director Richard Hodes, citing data from the U.S. Bureau of the Census, informed the Subcommittee that today there are approximately 35 million Americans ages 65 and over. At the same time, diseases of aging continue to affect many older men and women, seriously compromising the quality of their lives. Cardiovascular disease, cancer, and diabetes also remain common among older Americans, observed Hodes.

He highlighted that the NIA is working to translate research findings into action through its highly successful campaign to encourage older people to exercise. The Institute is also working to reduce “troubling health disparities” that still exist among different racial and ethnic groups. To address disability and disease in special populations, Hodes explained that the Institute has implemented a major new study of health disparities, Health Aging in Nationally Diverse Longitudinal Samples (HANDLS). The study focuses primarily on cerebrovascular health, cardiovascular health, age-associated changes in cognition, and strength and physical functioning.

Through the study, NIA hopes to address hypotheses about aging and health disparities in minority and poor populations to understand the significance of environmental and genetic risk factors for disease.

The Institute is also interested in diabetes in the elderly. Hodes noted that last year investigators in the multi-institutional Diabetes Prevention Program (DPP) reported that people who are at high risk for diabetes can sharply reduce their risk through a low-fat diet and a moderate exercise regimen. The effect was most pronounced among study participants age 60 and over. He emphasized that NIA, along with other ICs, are continuing to follow up with DPP participants to determine long-term effectiveness of the interventions.

National Institute on Alcohol Abuse and Alcoholism (NIAAA) – According to NIAAA Director Ting-Kai Li, the Institute’s alcohol prevention research is aimed at reducing the causes and consequences of alcohol abuse and alcoholism. For example, said Li, “whether the relationship between early onset drinking and subsequent alcoholism is one of cause and effect or the result of these factors that predispose people to both those behaviors, and others, is unclear.” NIAAA is conducting studies that develop and test strategies to prevent drinking by youth of different ages and backgrounds. Particularly important among these, he emphasized, are longitudinal studies that can tell us whether strategies that show promise among a given subgroup of youth, such as rural adolescents, are successful or can be adapted for others, such as urban

youth. These studies examine the impact of a number of factors, such as school programs, parental and family influence, peer influence, alcohol advertisements, and community policies and practices, Li stressed.

Li then explained that NIAAA's prevention research also focuses on the general population and segments with unique needs. This includes pregnant women and the elderly, who may be prone to depression and dangerous interactions between alcohol and prescription drugs.

National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) – “Obesity is a complex problem requiring a multi-disciplinary research approach if we are to reverse this ominous threat to our nation's health,” observed NIDDK Director Allen Spiegel. He emphasized that “we must approach obesity not as a cosmetic or moral problem, but rather as a health problem.” To address the obesity epidemic now occurring globally, Spiegel stressed that “research is vital.” According to the Director, NIDDK and NIH are “formulating a bold and coordinated research plan.”

Spiegel informed the Subcommittee that obesity and its associated diseases result from complex interactions of biologic and environmental factors. The environmental factors include social, demographic, and economic changes that encourage people to eat more food than necessary to meet their energy requirement, and discourage physical activity that would increase their energy expenditure. “These environmental factors disproportionately affect individuals who are biologically more susceptible to becoming obese and to develop obesity-associated diseases,” he observed.

Progress in behavioral research, Spiegel noted, provided the basis for the lifestyle intervention of the Institute's Diabetes Prevention Program (DPP). NIDDK is conducting a follow-up DPP Outcomes Study to assess the durability of the DPP interventions in preventing diabetes, and to determine whether the interventions reduce cardiovascular disease.

Spiegel observed that in behavioral research the Institute has begun a clinical trial to develop effective strategies to prevent Type II diabetes in children. The initiative focuses on school-based primary prevention programs to decrease risk factors for Type II diabetes and lower the incidence of the disorder. NIDDK is also supporting research to translate the results of the DPP program into clinical practice for prevention of

Type II diabetes in individuals and communities at risk. Spiegel emphasized that interventions that focus on underserved and minority populations disproportionately affected by the disease will be of particular interest. “Given the environmental influences fueling the obesity epidemic, we are encouraging research to study promising interventions that would target environmental factors contributing to inappropriate weight gain in children, adolescents and adults,” the NIDDK Director emphasized.

Spiegel underscored that the Institute is asking investigators to partner with community organizations or businesses to develop interventions that could potentially be expanded to a larger scale.

National Heart, Lung, and Blood Institute (NHLBI) – The well-known good news is that heart disease rates have been plummeting for decades, and serious disease manifests itself much later in life. The bad news is that an acute problem has become a chronic problem that affects millions of Americans, observed NHLBI Director Claude Lenfant.

Lenfant highlighted findings from “recent clinical trials that have enormous practical significance for disease prevention and treatment.” He also noted that two of the most pressing public health priorities today are obesity and diabetes, conditions that have become epidemic in modern America. According to Lenfant, both are the special focus of concerted NHLBI attention because their victims are inordinately susceptible to cardiovascular disease complications. Accordingly, the Institute is undertaking new programs in both areas, with the ultimate goal of reducing the toll of such complications, noted Lenfant.

He informed the Subcommittee that innovative worksite interventions for preventing and controlling obesity in adults will be designed and tested. He explained that “although traditional obesity-controlled strategies have focused on the individual, the workplace constitutes a promising location for making positive, long-lasting behavioral and environmental changes that may affect a broad range of adults.”

In diabetes research, Lenfant emphasized that a major new clinical trial will test approaches to lowering cardiovascular disease in adults with Type II diabetes. The ACCORD (Action Control Cardiovascular Risk in Diabetes) study will evaluate the effects of intense blood sugar control with very aggressive control of blood pressure and lipids.

National Institute on Drug Abuse (NIDA) – Acting NIDA Director Glenn Hanson observed that his Institute is becoming increasingly knowledgeable about the impact of stress on brain function. According to Hanson, stress can be a major factor in both the initiation of drug abuse and is known to be one of the most powerful triggers to a relapse of drug abuse in former addicts. As progress is made in the understanding of the ways in which stress and drugs affect common mechanisms, prevention, and treatment strategies that more effectively satisfy the needs of the patients, particularly those who suffer from co-morbid substance abuse and mental disorders, can be developed, said Hanson.

There is good news in the epidemiology and prevention arena, noted Hanson. NIDA's long-standing Monitoring the Future Survey, which measures drug use among eighth, tenth, and twelfth graders, showed substantial decreases in the overall use of all illicit drugs, as well as a reduction in the use of cigarettes, marijuana, club drugs, and alcohol in the past year. Hanson attributed these downward trends, in part, to NIDA's prevention and education efforts.

Understanding adolescent decision-making is an important research area being addressed in NIDA's prevention portfolio, underscored Hanson. Preventing the initial use of drugs and stopping the progression of drug use before it escalates to addiction, Hanson emphasized, are two targeted objectives of the Institute's National Prevention Research Initiative (PRI). The PRI supports multi-disciplinary teams of basic researchers, community leaders, prevention specialists, clinicians, and health care providers, he concluded.

SENATE SUBCOMMITTEE DISCUSSES THE JUDICIAL CONFIRMATION PROCESS

By convening a May 6 hearing entitled "Judicial Nominations, Filibusters, and the Constitution: When a Majority is Denied Its Right to Consent," Senator John Cornyn (R-TX) focused attention on the increasingly bitter contests to confirm federal judges. Cornyn, Chairman of the Senate Judiciary Subcommittee on the Constitution, emphasized the importance of a fresh start for the Senate judicial confirmation process: "Never before has the judicial confirmation process been so broken, and the constitutional principles of judicial independence and

majority rule so undermined," he asserted. The Chairman asked the Senate to not only focus on the judicial confirmation process, but constitutional democracy.

Countering Cornyn, some Senators argued that the judicial confirmation process was not on a downward spiral. Sen. Charles Schumer (D-NY) stated, "When it comes to the current problems, I think it's hard to say that the system is broken." He also posited that a number of current judicial confirmations are halted because "President Bush chooses judges through an ideological prism."

After remarks from the Senators, Cornyn asked a panel of legal experts to offer some insight as to how to rectify the judicial confirmation process. Douglas W. Kmiec, Dean of the Catholic University Law School, offered a simple solution: follow the law of the Constitution: "The Senate has a constitutional responsibility to exercise its advice and consent function and hold up or down votes on all judicial nominees within a reasonable time after nomination," he concluded. John C. Eastman, Professor at Chapman University School of Law, focused his argument on the use of the filibuster. Eastman stressed that he does not oppose the use of a filibuster, however, he does think "it is extremely important to distinguish between the *use* of the filibuster and the *abuse* of the filibuster to thwart the will of the people." Eastman argued that the abuse of the filibuster will intrude upon the Presidential power to nominate judges and will eventually threaten the independence of the judiciary itself.

Moreover, Steven Calabresi, Professor of Law at Northwestern University, discussed several reasons why allowing filibusters during judicial confirmations is a bad idea. Calabresi declared that filibusters: 1) weaken the power of the President; and 2) violate the separation of power by giving a Senate minority the power to impose crude litmus tests. Rounding out the panel, Michael J. Gerhardt, Professor at the William & Mary Law School, presented an alternative viewpoint. Declaring that there is clear constitutional authority for the filibuster, Gerhardt noted, "The filibuster has the same claim to legitimacy as do each of these other features of the Senate." Filibusters, he added, act as a "additional salutary effect" to apply pressure on the President and Senate to find common ground to resolve their differences. Gerhardt concluded, "I believe the filibuster is not only constitutional but can facilitate compromise in an era in which many complain about its absence."

However, finding a common ground may be rather complicated. Democrats are displeased Senate Majority Leader Bill Frist (R-TN) introduced a resolution May 9 to

change Senate rules to prevent a minority from indefinitely delaying a vote on executive and judicial nominations. Under Frist's proposal, motions to invoke cloture, or limit debate, on nominations would be subject to declining majority votes. Although Frist only needs 50 supporting votes to move the bill to the Senate floor, the prevailing thought is that not all Republicans support the rule change, but Judiciary Committee Chairman Orrin G. Hatch (R-UT) and Cornyn might. The Rules and Administration Committee, chaired by former Senate Majority Leader Trent Lott (R-MS), plans to hold at least one hearing, and possibly more, on the resolution.

AAAS HOLDS FORUM ON BEHAVIORAL GENETICS AND SOCIETY

On May 1-2, scientists from a wide range of the life sciences, as well as bioethicists, policy makers, community groups, religious leaders, science educators and writers, legal scholars, clinicians, and the media participated in the two-day forum, *Can We Talk? A Public Conversation About Behavioral Genetics and Society*, designed to begin a public dialogue on the topic. The American Association for the Advancement of Science (AAAS) and the Hastings Center sponsored the event.

Emphasizing that “science should not – cannot – be inhibiting, even if we are afraid of what we will find,” former National Institute of Mental Health (NIMH) Director Steven Hyman, now provost at Harvard University, gave the keynote address. Science must strive for neutrality and objectivity. We must be prepared to “manage the consequences,” Hyman stressed. He urged researchers to fight politicizing impulses and to restrain themselves from engaging policymakers prematurely. He cited the controversy surrounding the child development issue of zero to three as an example of what can happen when this occurs.

According to Hyman, the promise of genetics will contribute to: 1) the understanding and treatment of mental illness; and 2) human self-understanding by illuminating mechanisms of brain development and plasticity. Behavioral genetics is a necessary field because the brain is too complex to understand without genetic tools, he noted.

“It is our brains, not our genes, that will ultimately control behavior,” Hyman stressed, noting that it is critical not to leave the brain out. Genes play a major

role in risk of mental disorders, he explained. For all common behavioral phenotypes, genes exert an effect but are not causal. Genes by themselves do not predict, he emphasized, and added that the model of behavioral genetics that the public has is clearly wrong.

Hyman also explained that the main problem for the genetic study of behavioral disorders is the difficulty of defining phenotypes, the apparently large number of genetic and non-genetic risk factors involved, and the complexity of their interactions.

Ethical, Legal, and Social Issues

Noting that because genotypes only give probabilities, Hyman underscored that there is a real risk of misuse of genetic information to discriminate in health insurance, educational opportunity, and employment.

Genes, explained Hyman, set the stage. However, brain development involves a hierarchical interaction of genetic, environmental, stochastic, and chaotic factors. Neural circuits are shaped by gene-environmental interactions over a lifetime. Experience physically changes the brain. The environment alters gene expression across the life span, Hyman explained.

It is early yet in our understanding of how physiology relates to cognition, emotion and behavior, the former NIMH director noted. There is a long way to go and genes are an important part. But ultimately reductionist strategies alone will not provide answers.

Finally, Hyman stressed the need to have more people involved in the conversation, including behavioral scientists. We need substantial interdisciplinary conversations. Many geneticists do not recognize how problematic the behavioral phenotype is, he concluded.

'Genetically Influenced Does Not Equal Genetically Determined'

According to University of Minnesota behavioral geneticist Matt McGue, the salient feature of human behavior is diversity. McGue explained that behavioral genetic research has radically changed our view of the nature and origins of individual differences in human behavior. Genes are important. The environment is also important, but perhaps in unexpected ways. Genetically influenced does *not* equal genetically determined, McGue stressed.

Genetic factors clearly play some role in shaping personality and conveying vulnerability to mental illness. Yet, the same behavioral genetic research that implicated

the importance of genetic factors also unequivocally established the significance of environmental influence, he continued.

According to McGue, IQ has been going up three to five points a decade. A phenomenal rise, he noted. But we don't know why. It cannot be genetics, McGue explained, it has to be our environment. The same thing is going on for height, which is highly heritable. When we do find the genes, it will not provide the explanation for these phenomena. He explained that the environments we experience are in part a function of the choices we make and the reactions our behaviors evoke in others. Behavioral genetic research provides no support for the proposition that human behavior is genetically determined, he emphasized.

Behavioral geneticists have moved beyond old battles over "nature versus nurture" to focus on investigating the complex gene-environment interplay that underlies individual differences in human behavior. Progress will be impeded by both a failure to recognize the existence of genetic contributions to human behavior as well as failure to acknowledge the fundamental significance of environmental influence, he stressed.

The Hasting Center's Erik Parens cautioned that the "heritability" concept is "slippery and easily misinterpreted," and when some groups compare themselves with others the results can be socially destructive. Parens cited the public debate regarding the heritability of IQ as an example.

Social Implications

The forum also included a discussion on some of the social implications of behavioral genetics research. In a presentation entitled, *DNA Markers and Behavioral Destiny: The Double-Edge of Genetic Explanations of Behavior*, New York University sociologist Troy Duster discussed three recurring themes in the public arena regarding the role of genetics in explaining behavior. According to Duster, there are social implications to accepting or rejecting the role of genes on our behavior.

Duster, a former COSSA Congressional Seminar speaker on this topic, noted the first theme is that since some genetic information has an apparently predetermined outcome we therefore can do little or nothing about it. He noted that sometimes that is true (epicanthic fold, blood type O, certain single-gene disorders), while there are other conditions or situations where human intervention is routine and effective (surgical laser operations for conditions such as myopia). The problem lies, says Duster, in those situations in which we tend to make the mistaken leap that genetics constitutes destiny. "The social policy and social actions implications of these beliefs about the relationships between genetics and behavior are deeply consequential," he stressed.

The second theme, says Duster, is the idea that genetic information is precise and definitive. This is true sometimes, as in the case of DNA markers so precise that they can definitively get someone off of death row. In the case of Huntington's Disease, however, it is now possible to be tested and learn whether one has the gene for the disease. But even with this knowledge, one cannot know at what age it will strike. Moreover, explained Duster, even if it does strike, one cannot know in advance the severity or location of where a particular form of debilitation might occur.

The third theme, Duster explained, is the emerging controversies that will surround the creation and use of national DNA databanks. Duster underscored that "the tension between a sense of security versus a sense of freedom will be experienced in a classical *danse macabre*. As threats of terrorism, real and imagined, capture our attention, the tilt toward having everyone's DNA stored in some accessible spot that can quickly be retrieved and analyzed by speedy computer technology," will be profound, Duster observed.

A copy of the COSSA seminar on this topic can be requested by e-mailing cosssa@cosssa.org.

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SOURCE OF RESEARCH SUPPORT

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NSF Seeks Science Of Learning Center Applicants

The National Science Foundation (NSF) is seeking applications for the new Science of Learning Center program (SLC). The announcement may be found at: www.nsf.gov/pubs/2003/nsf03573/nsf03573.htm.

The SLC offers awards for large-scale, long-term Centers that will extend the frontiers of knowledge on learning. Centers should be built around a unifying focus that will incorporate a diverse, multidisciplinary environment involving appropriate partnerships with academia, industry, all levels of education, and other public and private entities. NSF hopes to make three to five Center awards in FY 2003-2004 for up to ten years at \$3-5 million per year.

The program will also make Catalyst awards to enable partnership building and research activities leading to the creation of new Centers. NSF expects to make 20 or more of these awards in the first few years of the program.

The Centers should create an intellectual, organizational, and physical infrastructure needed for long-term advancement of knowledge research. Areas of investigation include: psychological, social, and pedagogical needs of learning, the biological basis of learning, machine learning, learning technologies, and mathematical analyses and modeling of all of these. In addition to the interdisciplinary research team with a long-term vision, the Center needs a director and leadership team qualified to implement and manage a strategic plan for accomplishing its goals.

NSF plans to convene workshops during the Spring of 2003 to educate potential applicants. Check the website at: www.nsf.gov/slc for more information. Letters of intent are required and are due **August 5, 2003**. The full proposal deadline is **August 5, 2003** for Catalyst Awards and **September 17, 2003** for Center Awards. For further information contact Steve Breckler at (703) 292-8728 or sbreckle@nsf.gov.

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