NATIONAL ADVISORY COUNCIL FOR HUMAN GENOME RESEARCH
SUMMARY OF MEETING[1]
February 11-12, 2013

The Open Session of the National Advisory Council for Human Genome Research was convened for its 67th meeting at 10:00 A.M. on February 11, 2013 at the Fishers Lane T– Level Conference Center in Rockville, MD. Dr. Eric Green, Director of the National Human Genome Research Institute, called the meeting to order.

The meeting was open to the public from 10 A.M. until 6:00 P.M. on February 11, 2013. In accordance with the provisions of Public law 92-463, the meeting was closed to the public from 8:00 AM to 10:00 AM on February 11, 2012 and from 8:00 AM until adjournment at 4:00 PM for the review, discussion, and evaluation of grant applications.

Council members present:
Joann A Boughman, *ad hoc*
Carlos Bustamante
Lon R. Cardon, *ad hoc*
Joseph Ecker, *ad hoc*
James P. Evans
Ross C. Hardison
Howard J. Jacob, *ad hoc*
David M. Kingsley
Amy L. McGuire
Howard L. McLeod
Deirdre R. Meldrum
Jill P. Mesirov
Anthony P. Monaco
Robert Nussbaum, *ad hoc*
Lucila Ohno-Machado, *ad hoc*
Pilar N. Ossorio, *ad hoc*
Arti Rai, *ad hoc*
Pamela L. Sankar
David R. Williams
Richard K. Wilson

Council members absent: None

[1] For the record, it is noted that to avoid a conflict of interest, Council members absent themselves from the meeting when the Council discusses applications from their respective institutions or in which a conflict of interest may occur. Members are asked to sign a statement to this effect. This does not apply to “en bloc” votes.

Staff from the National Human Genome Research Institute:

Alexi Archambault, ERP
Alice Bailey, DPCE
Jessica Barry, ERP
Maggie Bartlett, DPCE
Steve Benowitz, DPCE
Vivien Bonazzi, ERP
Vence Bonham, DPCE
Ebony Bookman, ERP
Joy Boyer, ERP
Comfort Browne, ERP
Shaila Chhibba, ERP
Monika Christman, ERP
Debra Colantuoni, ERP
Priscilla Crocket, ERP
Chris Darby, ERP
Christina Daulton, DPCE
Camilla Day, ERP
Elise Feingold, ERP
Adam Felsenfeld, ERP
Kim Ferguson, ERP
Ann Fitzpatrick, DM
Colin Fletcher, ERP
Tina Gatlin, ERP
Zivile Goldner, ERP
Peter Good, ERP
Bettie Graham, ERP
Mark Guyer, ERP
Linda Hall, ERP
Joseph Henke, DM
Lucia Hindorff, ERP
Sara Hull, DIR
Heather Junkins, ERP
Rongling Li, ERP
Nicole Lockhart, ERP
Carson Loomis, ERP
Lindsey Lund, ERP
Chengetai Mahomva, ERP
Allison Mandich, IOD
Terryn Marette, ERP
Ian Marpuri, ERP
Omar McCrimmon, DPCE
Glen McFadden, ERP
Keith McKenney, ERP
Ray Messick, ERP
Janis Mullaney, DM
Jim Mullikin, DIR
Ken Nakamura, ERP
Vivian Ota Wang, ERP
Brad Ozenberger, ERP
Betsy Parker, DM
Eugene Passamani, ERP
Michael Pazin, ERP
Jane Peterson, ERP
Ajay Pillai, ERP
Lita Proctor, ERP
Erin Ramos, ERP
Steven Robinson, DPCE
Laura Rodriguez, DPCE
Ellen Rolfes, DM
Tamar Roomian, ERP
Karen Rothenberg, IOD
Jeffery Schloss, ERP
Michael Smith, ERP
Heidi Sophia, ERP
Jeff Struewing, ERP
Yekaterina Vaydylevich, ERP
Simona Volpi, ERP
Lu Wang, ERP
Kris Wetterstrand, IOD
Anastasia Wise, ERP
Xiao-Qiao Zhou, ERP

Others present for all or a portion of the meeting:
Nakela Cook, National Heart, Lung, Blood Institute
Ellen Giarelli, International Society of Nurses in Genetics
Garry Gibbons, National Heart, Lung, Blood Institute (NHLBI)
Tabitha Hendershot, RTI International
James O'Leary, Genetic Alliance
Mario Rinaudo, National Institute of Nursing Research (NINR)
Rhonda Schonberg, National Society of Genetic Counselors
Barbara Thomas, Center for Scientific Review (CSR)

INTRODUCTION OF NEW COUNCIL MEMBERS AND STAFF, LIAISONS, AND GUESTS

DIRECTOR'S REPORT

Dr. Eric Green presented the Director's Report to Council.

Council inquired if the UK plan to sequence 100,000 British Genomes is conducting germline sequencing and whether there will be a tumor bank for cancer patients. Based on Dr. Green's previous discussions with Mark Guyer and Mark Walport, Dr. Green anticipates that they are in the early stages, but do not have definite plans.

Council asked for comments on NHGRI connections to the Million Veteran Program and whether NHGRI provides input for that program. Dr. Green replied that only discussions have occurred at this point and details to the extent of NHGRI participation are yet to be determined. Dr. Manolio commented that investigators are collaborating with eMERGE. Dr. Green commented that NHGRI invites Veterans Affairs to participate in relevant activities as they develop. Council member Robert Nussbaum commented that he and Cynthia Morton are on their Genome Medicine Advisory Board and offered to provide input through those means.

PRESENTATION BY THE NHLBI DIRECTOR

Dr. Gary Gibbons, NHLBI Director, gave a presentation entitled, "Imaging the Future – the NHLBI at 75; Toward a Diverse, Networked Scientific Community."

Council asked for comments regarding the issue of minorities falling out of the "pipeline" and how can we overcome the problem in the gap between kindergarten through twelfth grade education and undergraduate education. Dr. Gibbons commented that this is not readily solvable and that NIH cannot start early enough. Gibbons suggested that NIH make a strategic decision on education. Many incoming minority freshman still have an intention to pursue a career in science. However, minorities pursuing a doctoral degree experience a steep decline in numbers. NHLBI has a program that relates to reducing financial burden of attaining a higher education because scholarship and loan repayment options can lower the financial hurdle for minority groups. In addition, Dr. Gibbons suggested mentorship programs to ensure minority students have opportunities and guidance.

Council inquired about NHGRI's advisory role across other institutes. Dr. Gibbons commented that the collaboration between institutes is important. Especially based on the current financial climate, institutes must collaborate rather than work separately. Dr. Gibbons responded that institutes can work collectively on programs that can apply to many diseases. NHGRI is

especially interested in cross-cutting platforms and NHLBI and NHGRI continue to have plans to collaborate.

PROJECT UPDATES

The Cancer Genome Atlas (TCGA)

Dr. Bradley Ozenberger presented an update on TCGA.

Council asked how the ICGC project complements TCGA. Brad replied that TCGA is a major part of ICGC and a bulk of the data in ICGC. ICGC and TCGA meet once a year. In addition, there are coordinated efforts for some tumor projects. For example, prostate project has been synergized across that consortium. ICGC has their own database out of the University of Toronto and TCGA deposits their data in that database. Dr. Guyer commented that the analysis groups have become much bigger than the TCGA funded groups. There has been wide community involvement in the analysis. Experts in each disease are invited to contribute and are encouraged to contact Dr. Ozenberger to be involved.

Council inquired about the difference between the analysis centers and the genome characterization centers. Dr. Ozenberger responded that the genome characterization centers generate the data, RNA analysis, SNP chip array, and other analysis not achieved by bulk genome sequencing. The analysis centers are strictly computational.

Council inquired if there are plans to add epigenetic analysis plans. Dr. Ozenberger responded that there are residual tissues that remain in the bank that TCGA would like to make available in the future. Protein analysis has started with phosphoprotein chips. Currently, epigenetic analysis is not part of the project.

Council asked if, given the current clinical translation findings, whether the current infrastructure of TCGA could be used to analyze tumors before and after patients have received treatment(s) for their cancers. Dr. Ozenberger replied that NCI is currently moving towards making all clinical trials “genomically-enabled.” But a specific characterization of tumors before and after treatment would be a study that NCI would carry out on their own. TCGA could take advantage of the current infrastructure for other clinical research in the future.

Council asked for clarification regarding the degree of stratification for each tumor type. Dr. Ozenberger responded that TCGA consists entirely of primary tumors. Occasionally TCGA has several samples from the same patient. Council also asked for clarification regarding the level of tumor heterogeneity. Dr. Ozenberger responded that a pilot in that area is possible, but currently we did not do the accrual in such a way to take samples far apart geographically. Heterogeneity is done simply by one sample. Dr. Wilson commented that the Acute Myeloid Leukemia (AML) dataset has extensive heterogeneity in the primary tumors, and commented that we can also see the field effects of breast cancer. Dr. Ozenberger commented that further analysis will be deferred for the next phase of TCGA.

Council inquired about the technological development regarding the way tissues are handled. Dr. Ozenberger responded that TCGA only utilizes tissues for good quality data and Formalin-Fixed, Paraffin-Embedded (FFPE) tissues are very important for the future.

Genotype Tissue Expression (GTEx)

Dr. Simona Volpi presented an update on GTEx.

Council asked for a description of the ELSI (Ethical, Legal, and Social Implications) component of GTEx. Dr. Volpi commented that the ELSI project focuses on the next of kin and how the family feels about the process of consent for the program. The donors' families are interviewed after the consent process regarding how they felt and what they understood about the consent process and study. GTEx tries to incorporate their suggestions in the review of the consent process.

Council inquired about the acceptance and rejection criteria for donors. Dr. Volpi responded that donors must be between 21-70 years old and have a BMI (Body Mass Index) between 18 and 35. In addition, donors must be free of major disease, such as cancer. Dr. Volpi added that GTEx also considers how the samples are obtained. The criteria for organ procurement organizations are also used by GTEx. Council inquired if the samples were from organ transplants. Dr. Volpi confirmed that most are organ transplants or rapid autopsy. Council asked if there is ever conflict with the organ procurement organizations. Dr. Volpi confirmed if they qualify for organ procurement, they also qualify as GTEx cases.

Human Heredity and Health in Africa (H3 Africa)

Dr. Jane Peterson presented an update on the Common Fund H3Africa Program.

Council asked if the biorepository projects are separate or serve as support for other research projects. Dr. Peterson confirmed that the bio-repositories support the other projects and that their collections are driven by the other projects. No samples will be sent to the biorepositories until H3Africa has a scaled-up repository, which will take years. Council asked what the biorepositories will be banking. Dr. Peterson replied that they will be primarily banking blood, along with some other sample types, for example, microbiome data.

Council asked for comments regarding the financial oversight of H3Africa. Dr. Peterson responded that the NHGRI Grants Management team joins the H3Africa Program staff for site visits. There is also an independent expert committee of advisors that work with the Wellcome Trust and meet twice a year. Dr. Peterson added that H3Africa does not have a special program for financial oversight, but the grants management team is well informed. Dr. Guyer added that when grants management staff members attend site visits, they meet the grants management team of grantee's institution and learn about their systems, including how much they know about the NIH's systems. There is also a component that is linked to the NICHD program, which trains grants management staff of low and middle income countries. NICHD has agreed to include one person for each H3Africa institution in that program.

Council inquired if the funding agencies in Africa specifically involved the West African Research countries. Dr. Peterson responded that H3Africa corresponds with research ministers or national ministers for research in the different countries. H3Africa has invited NEPAD (New Partnership for Africa's Development), a relatively new African organization that encourages African governments to spend more money on science. They attended the first consortium meeting.

Dr. McLeod commented that Accra has been a major node for the World Health Organization programs over the last 20 years and may have potential funds. Dr. Guyer added that each institution must have a letter from their country's appropriate ministry (health or science) supporting the research proposed in the application.

Council inquired if H3Africa leverages the Medical Education Partnership Initiative (MEPI), since they already have experience managing grants in Africa. Dr. Peterson responded that they collaborated with MEPI to create an electronic submission template, since they also experienced the same difficulties receiving electronic submissions. Dr. Peterson explained that MEPI is a program run by the Fogarty Center the MEPI sites are located at President's Emergency Plan for AIDS Relief (PEPFAR) institutions. MEPI is focused on medical education, with less attention to the support of research in common with some of the H3Africa grantees. Dr. Peterson added that they encourage grantees at MEPI and grantees of H3Africa to attend each other's meetings when possible, and we do hope to meet jointly with them.

Dr. Green asked for comments regarding the involvement of other NIH institutes with the H3Africa program. Dr. Peterson replied that one institute has provided funding for one of the H3Africa grants. Several other NIH institutes have expressed willingness to contribute funds if the right application is received. For example, National Institute of Allergy and Infectious Disease (NIAID) and the Office of AIDS Research have contributed to projects conducting AIDS research. Dr. Green added that NHGRI is trying to leverage Common Fund dollars as well as funding from other institutes. He, Dr. Guyer, and Dr. Peterson spoke to NIH Institute/Center (I/C) directors asking them to add additional funds to Common Fund. While not all I/C Directors were interested in contributing funds directly to Common Fund, some institutes are now funding individual grants that are of interest to them.

Biennial Report on Inclusion of Women & Minorities in NHGRI-Supported Research

Dr. Rongling Li presented the report on Inclusion of Women & Minorities in NHGRI-Supported Research.

Council asked if NHGRI should consider if there are sufficient numbers of a particular racial/ethnic group to answer a scientific question. Council was concerned that while there was an increase in the percentage of minorities, it was not clear if the increased number was indeed beneficial. Council suggested going beyond the congressional mandate.

Dr. Bettie Graham commented that part of review criteria is to determine that the number of minorities is sufficient for their analysis. Council commented that that is not usually the primary aim during review. Dr. Rudy Pozzatti commented that during reviews, projects targeting a large number and variety of individuals frequently receive comments that they do not have enough power for minorities, and NHGRI does not know if those studies are successfully able to answer research questions for all of the racial/ethnic groups that are collected.

Dr. Li responded that we need to know not only how to meet the requirement, but have enough minorities for the study to have power as well.

Centers of Excellence in Genomic Science (CEGS) Program Update

Dr. Jeffery Schloss presented an update on the CEGS program.

Council asked what is considered to be "high payoff" when the CEGS program announcement states that the program will accept high risk in order to achieve high payoff. Dr. Schloss responded that the science should change the way we attack a genomic problem, or the project should lead to the development of a new technology with the potential to advance the field of genomics.

Dr. David Kingsley presented "The Genomic Basis of Vertebrate Diversity."

The Council members asked several scientific questions about Dr. Kingsley's presentation. Are there any features around the regulatory elements that would increase the chance of recombination occurring or generating deletions? Council also asked if evolution was unidirectional if deletion was the mutational mechanism. Dr. Kingsley responded that there are some areas that are deleted repeatedly and do not have the same endpoints, resulting in staggered ends in different populations. There is a variety of molecular signatures suggesting that some areas are fragile and share some sequence relationships with fragile chromosome regions in humans. They have cloned the regions into yeast artificial chromosome clones. The marine sequence is fragile and the mutation process eliminates features that make the chromosome prone to breakage. However, when deletion occurs, the chromosome on which it occurs shows molecular signatures of positive selection. There is no reason to conclude that the region is decaying, but the area is prone to throw off adaptive alleles that are subject to positive selection in this population. Dr. Kingsley added that unidirectional evolution occurs when the deletion removes what is present in only one allele.

Council asked what occurs if one normalizes for the target size of coding region vs. noncoding region. Dr. Kingsley responded that it depends on how one counts the target size. The target size for the regulatory elements' surrogate would be accumulated conserved sequences found outside the exon that would be roughly equal to the target size because it is only a small fraction of the genome that is either coded or conserved noncoding. Nonetheless, a strong bias is seen. When the project began, he was not focusing on the coding vs. noncoding issue. When you compare those distributions of variation, the loci that look like they underlie adaptive change have a huge fraction of regulatory change.

Council commented that Susan Rosenberg has published extensively on the increased mutation rate in *E. coli* in response to environmental stresses. Council inquired if a shift of electrolytes and sodium content of the external environment might affects recombination and deletion. Dr. Kingsley responded that he is interested that the possibility of migration out of the ocean environment, which is both buffered in temperature and salinity, into freshwater environments with much more variable temperatures and salinity might influence the mutations that underlie some of the adaptations seen in fresh water. Dr. Kingsley added that he is studying the mutation mechanisms that underlie the deletion of the regulatory elements because he would like to determine if it is sensitive to environmental conditions.

Council inquired if the regulatory sequences are related to transposon sequences and whether they are new or ancient. Dr. Kingsley responded that he is just at the beginning of addressing this mechanism. There is one trait currently under study in his lab that could have that connection.

Dr. Green asked how the strategic goals have changed since this CEGS program started 10 years ago, and whether the flexibility of the CEGS program was instrumental to the scientific success of the research. Dr. Kingsley responded that when the CEGS was originally funded, William Talbot was the Principal Investigator and the project had other aims besides sticklebacks. The other focus of the project was studying gene duplication and sub-functionalization using zebrafish. Dr. Kingsley worked on both during the first five years, and thought the stickleback research was more successful than the zebrafish research. At the five year renewal point, Dr. Kingsley decided to focus only on sticklebacks. He is now also applying the principles learned in sticklebacks to other organisms and looking for patterns in gene evolution in other mammals. When the proposal was first put together, Dr. Kingsley noted some individuals viewed the stickleback research as the riskier part of the research plan. In fact, the opposite occurred in that more progress was made in the stickleback component of the research plan, and the CEGS program was flexible in allowing Dr. Kingsley to adjust the priorities of the Center.

Dr. Deirdre Meldrum presented "CEGS Micro-scale Life Sciences Center: Linking Multiple Whole-Genome Datasets from Single Cells to Understand Pathways and Disease."

Dr. Green asked how the program has evolved since it first started. Dr. Meldrum responded that when her team first started, they hadn't developed the single cell technology yet, but were interested in applying it to many different scientific questions. Their scientific advisory board advised them to focus. They focused on technology that would be effective and focused on two model systems. They do want to apply their technology to other systems, but they recognize the need initially to remain focused so that they can produce useful data. In the LINCS program, they have just started a collaborative project looking at oxidative phosphorylation with investigators at Columbia University. The program allows for some flexibility, but they also received a three-year review and a competitive renewal. By the time of their renewal, they had a more focused CEGS. Dr. Schloss added that it is difficult to decide which collaborators to continue working with for technology development in addition to deciding which biological applications to continue.

Council asked for comments concerning how the program is structured, specifically the five year-five year structure, and how Dr. Meldrum will maintain funding after the CEGS.

Dr. Meldrum thought the structure of the funding plan and competitive review was beneficial because the fields are moving rapidly and this forces her team to think carefully about what they do. A full ten-year funding plan could allow someone to not be as thoughtful. The funding amount depends on the scientific questions and scope of the project. There is some flexibility with the research questions applicants can come in with. Dr. Meldrum does have other funding, but the CEGS provides a core funding. They do complement with other funding and other studies.

Council asked about the commercialization of the technology of this CEGS and the issue of exclusive versus nonexclusive licensing. Dr. Meldrum responded that they work closely with Arizona Technology Enterprises (AzTE), which is flexible regarding exclusivity, and deals with technology on a case by case basis. Some parts of their technology could easily be commercialized. AzTE is informed about the bigger picture of their systems, so as they make decisions they do not lose in the long-term. The AzTE has a process on advertising and gaining commercial interest, which they are in the process of pursuing currently.

Council inquired if Dr. Meldrum had plans to study single cell resistance to chemotherapeutic agents. Dr. Meldrum noted they have not yet pursued this topic, but it is an area that she is interested in studying.
Dr. Schloss led a discussion on the renewal of the CEGS PAR.

Dr. Schloss reviewed the history of the solicitation, a description of the CEGS program, the CEGS application features, and the CEGS grant budget allocations. He asked the Council to consider the following questions: Should the CEGS program continue, and is the scope, budget level, and number of awards appropriate?

Council asked if there was any special guidance with respect to intellectual property (IP) across institutions. Dr. Schloss responded that NHGRI suggests that potential grantees negotiate IP before they receive the grant, but are open to suggestions regarding what language to include. Council commented that they were enthusiastic about the program, and appreciated the risk involved. Council added that the fact that the CEGS are investigator-initiated counter balances the NHGRI tendency to be heavy-handed with management of programs. Council also commented that considering that the CEGS are high-risk, the fact that half of the CEGS are renewed seems high. Dr. Elise Feingold commented that the grantees receive a rigorous administrative review. Having this feedback and advice could contribute to a higher success rate.

Council commented that the CEGS are unique and would like to see more funded. Council would like to see the program expanded, but they respect the budget constraints and see potential partnership capability with other institutes. Council commented that the ten-year time period was appropriate and that the limited time period provides some pressure for innovation Dr. Schloss asked if NHGRI should fund over ten CEGS, funds pending. Dr. Schloss commented on years where NHGRI funded multiple CEGS, NHGRI started the grants with lower budgets. Dr. Schloss confirmed that there have not been cases when NHGRI wanted to fund a CEGS but did not have the funds. Council commented that NHGRI should be prepared to fund more than ten.

Dr. Green inquired if we have asked for funding from other institutes. Dr. Schloss believes that mechanistically we could have another institute co-fund. Dr. Lisa Brooks commented that when other institutes join, the applications tend to focus on those relevant diseases. Dr. Schloss commented that the funding announcements are added to the early notification system so other institutes can see what NHGRI announcements are posted.

Council asked if the two million dollar amount in direct costs was an appropriate funding amount. Dr. Schloss responded that potential grantees may not request more than two million dollars. It was noted that the CEGS program started in 2000 and consequently inflation has occurred. Therefore, the value of the grant has decreased. However, NHGRI has not come up with a reason for changing the funding amount. The calculation does not include indirect cost for collaboration with another institution. Collaboration is encouraged.

Council asked about the average size of teams that are funded compared to individuals who leverage other sources of funding. Dr. Meldrum and Dr. Kingsley responded that their groups average 50 and 20.

Council commented that NIGMS has written a report for the Glue grants, which could be used to aid the CEGS.

Council asked if there was a way to partner CEGS with the SBIR portfolio. Dr. Schloss responded that SBIR is separately allocated. There is nothing to stop small business applicants, but CEGS funds are center funds, not SBIR funds and it would be complicated to combine them administratively.

COUNCIL INITIATED DISCUSSION

Dr. Eric Green led the Council initiated discussion. Council commented on the spectrum and breadth of the types of applications NHGRI is looking for and funding.

The Council noted the discrepancy between the number of Council-approved Concept Clearances compared to the number of FOAs NHGRI has funded, or that have become FOAs. Council commented that there are more cleared concepts than what can be funded with the current budget. Dr. Green responded by stating that NHGRI has understood Council's previous advice to be that it is better to launch a broader number of FOAs and then make judicious funding decisions that might mean less funding going to some FOAs (essentially making awards to only the very strongest applications). Consequently, more concept clearances may be approved than NHGRI can fully fund. The discrepancy may also reflect NHGRI's budget projections, which are rather conservative and based on certain assumptions.

Council commented that last year, there was a concept presented to Council that was approved, but an FOA was never issued. Council suggested that it would be useful to know if there are cases where there are no funds to support an actual FOA. Dr. Schloss responded that in view of the recent reorganization, NHGRI is formalizing internally the process it will follow to prepare and publish FOAs, and we have an improved process in place now. The approved concept in question is in the process of being written and will be published. The publication of this FOA was delayed by one year due to limited available funds.

ANNOUNCEMENTS AND ITEMS OF INTEREST

Dr. Rudy Pozzatti presented the American College of Medical Genetics and Genomics Report to Council.

Dr. Rudy Pozzatti presented the National Society of Genetic Counselors Quarterly Report to Council.

Dr. Rudy Pozzatti read the Memorandum of Understanding (MOU) a description of our relationship with Council. Dr. Pozzatti called attention to two changes made to the MOU as follows: (1) Requirement to conduct Special Council Review of any application in which the Principal Investigator would have more than one million dollars in direct costs from any combination of active grants, and (2) the matter of Expedited Council Concurrence (ECC), an NIH wide change that now allows institutes to bring certain application types to a subset of the Council members approximately one month before each Council meeting. The subcommittee of Council would perform the same review process that occurs in a full Council meeting and a report of the meeting would be included in the ECB. For NHGRI, this change applies to the SBIR and STTR applications. The ECC allows us to make an accelerated award, allowing NHGRI to have an early start on those applications.

CONFIDENTIALITY AND CONFLICT OF INTEREST

Dr. Rudy Pozzatti read the Confidentiality and Conflict of Interest policies to Council and asked the members to sign the forms provided.

REVIEW OF APPLICATIONS

In closed session, the Council reviewed 121 applications, requesting $71,333,023 (total cost). The applications included: 70 research project grants, 37 ELSI grants, 75 RFA applications, 9 research center grants, 2 conference grants, 2 career transition awards, 1 institutional training award, 10 SBIR Phase I applications, 1 SBIR Phase II application, 1 individual training applications, and 10 education project award. A total of 122 applications totaling $71,333,023 were recommended.

I hereby certify that, to the best of my knowledge, the foregoing minutes are accurate and complete.

5/21/2013
Date

Rudy Pozzatti
Rudy Pozzatti, Ph.D.
Executive Secretary
National Advisory Council for Human Genome Research

5/21/2013
Date

Eric Green
Eric Green, M.D, Ph.D.
Chairman
National Advisory Council for Human Genome Research