Charge to the Committee of Visitors (COV)

The NSF has become increasingly concerned with determining the effectiveness of the projects, programs, and overall set of activities it supports. Within the context of the Report Template for FY 2003 NSF Committee of Visitor (COV) Reviews, evaluate the performance of the Genes & Genome Systems Cluster, specifically with regard to: programmatic definition and vision, the process of review, the resulting awards portfolio, and the results of investments.

The COV will also address Cluster goals, opportunities, and future directions. In particular, the COV is asked to provide advice and insights into opportunities to better advance science and education within the areas of responsibility of the Cluster under review. Specifically, input from the COV that would be useful in setting program goals, priorities and future directions include identification of:

- emerging research opportunities, significant challenges within a field, or areas for growth or increased emphasis;

- factors that may represent barriers to progress within and among the fields represented by the Cluster, such as critical limitations in technology, methodology, or theory; and

- the unique role(s) that NSF plays in the area of Genetics and Genome Systems.

Using the FY 2003 Report Template for NSF Committees of Visitors, the COV will prepare and submit a report before the meeting is adjourned.

MCB Genes & Genome Systems 2003 COV
July 9-11, 2003
Room 375

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Diversity and Independence of Members
COV for Genes and Genome Systems Cluster
Division of Molecular and Cellular Biosciences, 2003
July 9-11, 2003

The COV had 12 members.

Distribution by sex: 4 women and 8 men

Distribution regarding disabilities: 12 with no apparent disability

Distribution by ethnicity: 10 White, 1 African-American, and 1 Hispanic

Distribution by type of Institution:
1 from Private Research Institute
1 from Private Universities
2 from Private Liberal Arts Colleges
6 from Public Universities
1 from a small Biotechnology Company
1 from another Government Agency (USDA)

Distribution by Geographic Area:
3 from Mid-Atlantic
1 from Northeast
3 from Southeast
1 from South
4 from Midwest

Distribution by NSF Experience:

1, NSF A/C member, current MCB awardee, no MCB panel service; served on prior MCB COV

3, no NSF funding, no past COV or panel service

2, no funding within last 5 years, no MCB panel service within last 5 years

1, current Plant Genome but not MCB, awardee, current Plant Genome panelist, no MCB panel service

2, current awardees, MCB panel service more than 3 years ago (One of these was on prior COV.)

3, current awardees, no MCB panel or COV service

_____
Mary E. Clutter
Assistant Director
BIO Directorate

FY 2003 Report Template for NSF Committees of Visitors (COVs)

Date of COV: July 9-11, 2003
Program/Cluster: Genes & Genome Systems
Division: Molecular and Cellular Biosciences
Directorate: Biology
Number of (Cluster) Actions reviewed by COV:
Awards: 75
Declines: 186
Other: Jackets selected by Programs: 19

Total Number of Actions within Program; Cluster; Division During Period Being Reviewed by COV.

Awards[1]: Program (below); Cluster (351); Division (994)
BGE: 89
Euk. Gen.: 124
Micro. Gen.: 138

Declines: Program (below);Cluster (898); Division (2,798)
BGE: 346
Euk. Gen.: 244
Micro. Gen.: 308

Other: Program (195[2]); Cluster (195); Division (649)

Manner in which reviewed actions were selected: *Except for jackets selected by programs to illustrate 'high', 'medium', 'low' rated proposals, all jackets were pseudo-randomly collected—every 5th jacket in files*.

PART A. Integrity and Efficiency of the Program's Processes and Management

A.1 Questions about the quality and effectiveness of the program's use of merit review procedures. Provide comments in the space below the question. Discuss areas of concern in the space provided.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCEDURES

Is the review mechanism appropriate? **Yes**

Is the review process efficient and effective?
There is adequate efficiency in most cases; however there was some confusion about what was meant by "effective". The conversion to Fast Lane makes both the submission, the University interactions with the

[1] Data from Program Annual Reports
[2] Combined for BGE, Euk. Gen., and Micro. Gen.

financial offices, and the submission of ad hoc reviews relatively painless and simple.

The COV did find a small number of examples that indicated that the completion of some reviews has been seriously delayed. For example, one application, chosen at random, indicated that the PI had not received written reviews of a very good application with only three weeks before the next submission date. This left the PI wondering what to do with this application in limbo and unable to submit a revised application for the next deadline. One recommendation is that the Division consider the feasibility of sending reviews out to PIs immediately following the panel meeting, at the very least for those proposals that will likely not be funded. In the NIH system, the content of reviews is entirely the responsibility of reviewers, and many panel members edit their reviews following panel discussion. There would be tremendous and immediate value to PIs to have reviewer's comments as quickly as possible after panel discussion, even though the likelihood of funding is still uncertain at that point.

Are reviews consistent with priorities and criteria stated in the program's solicitations, announcements, and guidelines? **Yes**
Our collective experience overall is that reviews are generally consistent with priorities for criterion 1. See A.2 for discussion of criterion 2.

Do the individual reviews (either mail or panel) provide sufficient information for the principal investigator(s) to understand the basis for the reviewer's recommendation?

In the aggregate the answer is yes, but there is great variability in the quality and quantity of reviews received. Individual proposals have received a mix of thorough, constructive reviews and very terse, ambiguous and ineffectual reviews. Improvement in this area is needed to provide PIs with faster, more effective feedback. The need to identify strengths and weaknesses could be stressed to reviewers, perhaps providing review templates or models that might raise the overall quality of reviews and make the quality of reviews more uniform.

Do the panel summaries provide sufficient information for the principal investigator(s) to understand the basis for the panel recommendation?

Often the panel summaries are adequate, but occasionally they are not sufficiently detailed. In addition, the COV found examples of significant variation in the quality of the evaluation and explanation of scientific criticism. Those who are most in need of specific comments are those whose applications fall in the uncertain middle. In one instance, a revised

application rated excellent in the first round was rated good on the second round, despite the fact that the Program Director wrote to the PI that the resubmission was actually better than the first application.

Possible recommendations include:
1. Developing a template to be used in the creation of the panel summary that lists primary strengths and weaknesses and any other relevant information that may improve the overall quality of the summary.
2. Extend the time scheduled for the panel so that sufficient time can be devoted both to discussing the applications as well as writing detailed panel summaries during the meeting.
3. Assign the task of creating the panel summaries to a science assistant, rather than to a panel member.
4. Assign the task of creating the panel summaries to the Program Directors (perhaps using the information that comes to be contained in the F7 form) rather than a panel member.
5. Include the analytical components of the F7 form in the material that is returned to the PI.

It should be noted that the COV does not believe that these recommendations are mutually exclusive.

Is the documentation for recommendations complete, and does the program officer provide sufficient information and justification for her/his recommendation?

Yes. The notes of the Program Officers were found to be more helpful and uniform than many critiques and panel summaries. This observation prompted the COV to make recommendations 4 and 5 above.

Is the time to decision appropriate?

On average, the dwell time for applications submitted in 2002 was just over 6 months; however, the dwell time within Microbial Genetics Cluster was significantly longer. How close this is to the NSF goal of 70% completed in six months cannot be determined. It was noted that overall dwell time has not changed much since 1997 but hopefully will decrease with the expansion of the Fastlane system.

Given the workload and complexity of the tasks that Program Officers must complete, the decision time seems appropriate. However, we suggest that the Division consider sending out improved panel summaries and reviews soon after the panel meetings, to allow PIs more time to incorporate suggested changes in their resubmissions and/or to carry out personnel planning within their lab, etc. In a discussion with Program Officers about this issue they indicated that they strive to quickly contact those PIs whose applications are in the 'gray area' so that they can have sufficient time to

prepare a resubmission. In some instances, the PIs are given leeway on the timing of their next submission (if necessary). We encourage the Program Officers to continue to work with the PIs in these ways as much as possible.

Discuss issues identified by the COV concerning the quality and effectiveness of the program's use of merit review procedures:

Based on the examination of jackets during the meeting, the COV discovered at least two examples in which a PI's current grant support has been an important factor in reaching a funding decision. At least two other applications with excellent evaluations were also declined, at least in part, because the projects were perceived to be either more appropriate for NIH or contained work that may overlap with current NIH support. Another application was deemed more appropriate for USDA. Since this information was not contained in the summaries, it was not relayed to the PIs. Not knowing the real reason for declining an excellent application can cause confusion, not to mention wasted effort, for a PI. If an excellent application is declined because of the perceived suitability for another agency, current PI grant support, or other reasons related to the objective quality of the proposals, we suggest that it should be unambiguously explained to the PI. For example, it should be explained that criterion 2 can be used to justify distributing limited funds to the greatest number of PIs doing excellent research as a way in which the NSF can increase its impact at various research institutions.

There is a general perception that the public at large does not yet realize that there has been a recent realignment within the MCB cluster in the way that applications are assigned for review. The Program Officers are encouraged to identify opportunities (attendance at meetings, etc.) to make this change known to their constituents.

Discuss issues or concerns in the space provided.

A.2 Questions concerning the implementation of the NSF Merit review Criteria (intellectual merit and broader impacts) by reviewers and program officers. Provide comments in the space below the question.

IMPLEMENTATION OF NSF MERIT REVIEW CRITERIA

Have the individual reviews (either mail or panel) addressed whether the proposal contributes to both merit review criteria?

All reviews that the COV examined evaluated the application with respect to criterion 1. This was not the case for criterion 2. For example, in Eukaryotic Genetics, the average percent of reviews that did not touch

upon criterion 2 was 23% over the three-year period examined, but that average has improved (10% in 2002).

Have the panel summary reviews addressed whether the proposal contributes to both merit review criteria?

Yes. For example, the percentage of reviews and panel summaries in BGE that addressed review criterion 2 reached 89% and 91%, respectively, between 2000 and 2002.

Have the review analyses (Form 7s) addressed whether the proposal contributes to both merit review criteria?

Yes. For example, in BGE, criterion 2 was addressed in 97% of Form 7s in 2002. In addition, the quality of the comments related to criterion 2 were deemed to be better and more informative in the Form 7s then in either the reviews or panel summaries.

Discuss any issues or concerns the COV has identified with respect to NSF's merit review system:

A.3 Questions concerning the selection of reviewers. Provide comments in the space below the question. Discuss areas of concern in the space provided.

SELECTION OF REVIEWERS

Did the program make use of an adequate number of reviewers for a balanced review?

The program requires a minimum of three reviewers, two of whom are panel members. In general, we feel that three reviewers are not enough for a balanced review because the panel members typically are not experts in the PI's field. However, the program director rarely relies on the minimum number and the norm has been about five reviews, which provide a balance between the views of the experts and the views of the panel members (who would be focused more on the big picture). Six ad hoc reviews are solicited and the return rate has been 30 - 45% during the past two years. The Program Officers did indicate that there has been a better return rate during the current year that is attributed to email reminders and personal phone calls.

Notwithstanding the success of the above process, the COV believes that the Divisions within BIO should re-examine the need for ad hoc reviews on ALL applications received. Solicitation of ad hoc reviews represents a

tremendous amount of work, and while these reviews have been shown to be of great value in some instances when the expertise does not exist on a particular panel, some members of the COV suggest that such reviews be obtained in a truly ad hoc basis, when necessary. This would allow the Program Officers additional time to devote to other aspects of their job.

Did the program make use of reviewers having appropriate expertise and/or qualifications?

Yes. To ensure that the reviewers have the appropriate expertise the program director uses a variety of resources relying heavily on the Internet. In addition to ad hoc reviewers suggested by the PI, the program director chooses reviewers from the proposal bibliography, Pub Med, the Science Citation Index, and recommendations from other experts in the field. The Program Officers noted that they spent a great deal of time locating email addresses; it would seem that this task could be assigned to an administrative assistant.

Did the program make appropriate use of reviewers to reflect balance among characteristics such as geography, type of institution, and underrepresented groups?

Reviewer balance was not examined because adequate information was not available. The COV recommends that such data be provided in the future if the NSF believes that this is an important issue.

Did the program recognize and resolve conflicts of interest when appropriate?

Yes.

Discuss any concerns identified that are relevant to selection of reviewers:

None.

A.4 Questions concerning the resulting portfolio of awards under review. Provide comments in the space below the question. Discuss areas of concern in the space provided.

RESULTING PORTFOLIO OF AWARDS

Overall quality of the research and/or education projects supported by the program.

The quality of supported research, particularly by established investigators who have received prior NSF support, is excellent. The CAREER proposals generally have excellent research and education components. Consistent

funding of programs showed a commitment to long range problems and high quality research.

Are awards appropriate in size and duration for the scope of the projects?

Award size and duration are appropriate given the funding constraints under which the Division operates. However, the awards are only sufficient to support relatively small projects. In an ideal world, the awards would be larger and longer, although we appreciate that every effort is being made to fund as many excellent projects as possible given the monies made available to the cluster. The issue of appropriation levels is addressed at the conclusion of this report.

Does the program portfolio have an appropriate balance of High Risk Proposals?

It is unclear exactly how a proposal is described as 'high risk'. Some applications are self-identified by funding mechanism, but others appear to be described as high risk by panel members and then labeled as such by Program Officers. These distinctions likely mean that high-risk proposals define a spectrum from those that represent cutting edge research that have a risky element to those that are largely or entirely risky. A scale to qualify the relative risk of a proposal would allow the overall risk of the portfolio to be better understood. About 50% of the applications in the high-risk pool (as currently defined) were funded in 2002, reflecting the general value placed on 'high risk-high payoff' proposals.

The COV recommends that for clarification the Division better define what is meant by high-risk research.

Does the program portfolio have an appropriate balance of Multidisciplinary Proposals?

Some multidisciplinary projects are supported by the Cluster. One large collaboration is noted in the 2002 annual report for Eukaryotic Genetics. BGE supported projects in biotechnology, chemical biology, computational modeling of biocomplexity, and mathematical biology. Whether this represents an "appropriate balance" is not possible to determine.

Does the program portfolio have an appropriate balance of Innovative Proposals?

The COV did not see any mechanism by which we could quantify what research was innovative. It is the opinion of the COV that essentially all of the work that the NSF funds should be innovative to one extent or another. As above, additional clarification on this topic is warranted if future COVs are to evaluate this parameter.

Does the program portfolio have an appropriate balance of funding for centers, groups, and awards to individuals?

Most of the awards were granted to individuals. Some grants provide support for conferences. The COV believes that this is appropriate given that we were reviewing a cluster within the MCB Division.

Does the program portfolio have an appropriate balance of awards to new investigators?

There was some ambiguity about the definition of new investigator – whether this refers to a beginning investigator or an investigator new to the NSF system. In addition, it was also difficult to interpret the data provided on the success rate of awards to "new" investigators since some of these investigators may have received an award from NSF but did not accept it if funding was also received by NIH. The Program Directors make a special effort to provide useful and timely feedback to beginning investigators in instances where an initial submission was declined.

Does the program portfolio have an appropriate balance of geographical distribution of principal investigators?

Information was only provided for the 2000 annual reports. Awards are fairly well distributed geographically in these reports.

Does the program portfolio have an appropriate balance of institutional types?

The balance is good overall. However, the number of proposals from undergraduate institutions is relatively low.

Does the program portfolio have an appropriate balance of projects that integrate research and education?

Yes.

Does the program portfolio have an appropriate balance across disciplines and sub-disciplines of the activity and of emerging opportunities?

Yes. The awarded applications represent the spectrum of research areas present in the applicant pool as a whole.

Does the program portfolio have appropriate participation of underrepresented groups?

The number of submissions from underrepresented groups is very low. However, the success rate of these proposals is quite good. For example, in Eukaryotic Genetics, 6/125 applications received were from underrepresented groups; 33%-68% were funded over the last three years reflecting the importance NSF places on supporting research from these groups.

Is the program relevant to national priorities, agency mission, relevant fields and other customer needs? Include citations of relevant external reports.

Yes, genetic and biochemical approaches to understanding biology underpin national research efforts to better define fundamental biological processes.

Discuss any concerns identified that are relevant to the quality of the projects or the balance of the portfolio.

A.5 Management of the program under review. Please comment on:

Management of the program:

The 1999 COV raised concerns about the lack of a permanent Program Director and a well-defined niche for BGE. Both of these issues have been resolved. In addition, the Program Officer's decision to assign proposals to Eukaryotic Genetics vs. BGE based on mechanisms rather than approaches is timely, redefines the niches for both programs, and is expected to enhance the effectiveness of the review process.

The COV recommends that at the conclusion of each panel, panel members should be given the opportunity to provide input on the positive and negative aspects of the review process (including ideas for improvement) as well as the overall performance on the program in meeting NSF goals (short version of some of the questions given to COV). Discussion of emerging trends and ways to "encourage" proposals from these areas should also occur. Input should be allow both orally at the time of the panel meeting in the form of a group discussion as well as written comments provided to the program officer and, if appropriate, the program or division director. This would be part of a continual evaluation and improvement process. In addition, a greater degree of flexibility and a culture of experimentation concerning alternative management and review procedures are encouraged.

Responsiveness of the program to emerging research and education trends:

The diversity of the portfolio, including the proposals that represent emerging areas of research, in very large part reflects work that is going on

within the community. While the COV discussions noted some potential drawbacks to this approach, the consensus was that the trends in funding emerging research are encouraging. For example, of the 23 high-risk proposals that were funded within BGE during the three-year period, 7 were in the RNAi research area, which has become a very hot topic in molecular biology.

The COV recommends that the Program Officers make use of the expertise that exists within their panels as another source of information about emerging trends in research. While this is being done within some panels currently, the COV believes that it could be done in a more consistent manner across all panels.

Program planning and prioritization process (internal and external) that guided the development of the portfolio under review:

Program planning and prioritization are driven partly by the "big picture," but mostly by what proposals actually are submitted. However, the discretion afforded to the Program Officers allows for tweaking of the portfolio of funded research projects to reflect what the Program Officers believe the best science to be in any given year. They appear to be doing an excellent job in this respect. In addition, the Program Officers also participate in scientific conferences and engage in internal "leading edge" discussions that together help to ensure that they stay current with the cutting-edge research areas within their respective disciplines.

Discuss any concerns identified that are relevant to the management of the program:

PART B. RESULTS: OUTPUTS AND OUTCOMES OF NSF INVESTMENTS

B. Please provide comments on the activity as it relates to NSF's Strategic Outcome Goals. Provide examples of outcomes (nuggets) as appropriate. Examples should reference the NSF award number, the Principal Investigator(s) names, and their institutions.

We have elected to respond to these questions with respect to the BGE portfolio as one set of examples; however, we believe that all three areas within the cluster have been performing at equally high levels.

B.1 NSF OUTCOME GOAL FOR PEOPLE: Developing a "diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens." Comments:

There was significant evidence that BGE has been very successful in achieving this particular goal. Specific examples are listed below by category.

- **Education of K12 students**
  - **Dr. P. Gottlieb (CUNY city college) hosts two Mott Hall Junior High School/STARS 8th grade students in his lab who are learning about the life of a scientist and are advised by Dr. Gottlieb in their school science fair.**
- **Education of undergraduate students**
  - **Dr. Anne Simon (U. MD College Park) received a supplement to support undergraduates in the Gemstone program at U Md College Park, an invitation-only group research program for the very top students at the University.**
  - **Dr. Charles Lovett (Williams College) received a new RUI award that will support his research in collaboration with undergraduate students, and summer camps for minority students and elementary school teachers.**
  - **Dr. Timothy Formosa (U of Utah) is incorporating undergraduate students, a high school biology class and students from the Navajo Nation in his research on a heterodimeric factor required for normal transcription and DNA replication.**
  - **Dr. Craig Vierra (U of the Pacific) received a RUI award to involve undergraduate students in research on bHLH family member E2A.**
- **Training of high school teachers**
  - **Dr. Anne Simon (U. MD College Park) received an RET supplement support two teachers during the summer of 2002.**
  - **Dr. Sabine Heinhorst received an RET supplement to a new award to support one teacher during the summer of 2002. Mrs. Helen Peterson is a biology teacher at Oak Grove High School in Hattiesburg Mississippi.**
- **Professional development of PIs**
  - **Dr Tien-Hsieng Chang (Ohio State U) received a supplement to support his sabbatical visit to the laboratory of M. Ares at UCSD to learn microarray techniques that Dr Chang will apply to his research on yeast Prp28.**
  - **Dr. Arik Dvir (Oakland U), formerly the recipient of a RUI award, competed successfully for a regular research award when Oakland U became ineligible for the RUI program.**

B.2 NSF OUTCOME GOAL FOR IDEAS: Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society." Comments:

Discoveries that contribute to the fundamental knowledge base: Dr. E. Stuart Maxwell at North Carolina State University (NSF Award 0215545) opened a new avenue of research toward understanding the biogenesis and function of the small nucleolar ribonuclear the protein (snoRNP) complexes essential for maturation of ribosomal RNA with his discovery of two critical accessory proteins.

Dr. Joseph Krzycki at Ohio State University (NSF Award 0114797) discovered a novel amino acid, pyrrolysine, in methanogenic archaea. This novel amino acid was unlike any of the known amino acids. This is only the second example since 1986 in which the standard genetic code has been shown to be altered by the inclusion of a novel amino acid into proteins. News articles described this discovery as "the biologist's equivalent of finding a new fundamental particle in physics".

Leadership in fostering newly developing or emerging areas: Dr. Shelley Berger at the Wistar Institute (NSF Award 0078940) defined a histone kinase that, together with a previously known histone acetyltransferase, alters histones at particular promoters. These findings demonstrate that histone modifications occur in certain patterns and support the novel "histone code" hypothesis.

Connections between discoveries and their use in service to society:
Dr. Cheng Kao at Indiana University (NSF Award 9807800) developed a method to reduce heterogeneity at the 3' ends of RNAs transcribed by T7 RNA polymerase. This method will make analysis of RNA structure and function less time consuming. Because of the potential uses of this methodology in the analysis of RNA, the journal Methods and Promega Notes are publishing updates of this methods and a patent was issued on this invention. He also developed a colorimetric RNA polymerase assay that will be useful for drug screens and real-time analysis of RNA polymerase activity. A patent will soon be issued for this technology.

Projects that are innovative and risky:

Dr. Chris Greer at the University of California, Irvine (NSF Award 0206374) received an SGER award to use the unconventional selection/amplification approach to look for splicing substrates of a novel splicing system in yeast that is completely distinct from the well-known spliceosomal machinery.

B.3 NSF OUTCOME GOAL FOR TOOLS: Providing "broadly accessible, state-of-the-art and shared research and education tools." Comments:

Dr. David Allison (University of Alabama, Birmingham; NSF Award 0090286) is developing software to facilitate genomic microarray analysis. This software is being made available via a publicly available website

(http://www.uab.edu/mar) and papers describing the methods have been published.

Dr. David Liu (Harvard University; NSF Award 0094128) has developed a new course in Chemical Biology, the materials for which have been used by colleagues at several other institutions to assist with their graduate-level education. All materials from that course can be accessed online at http://www.courses.fas.harvard/edu/~chem170 (username = chem170, password = fortytwo).

Several *Arabidopsis* 2010 awards will generate new technology. For example, Dr. Jonathan Arias (University of Maryland; NSF Award 0209697) is developing ChIP/chip technology that combines the use of chromatin immunoprecipitation and microarray analysis. Dr. James Carrington (Oregon State; NSF Award 0209836) is generating a database of small RNA information in Arabidopsis.

PART C. OTHER TOPICS

C.1 Please comment on any program areas in need of improvement or gaps (if any) within program areas:

C.2 Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions:

C.3 Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

C.4 Please provide comments on any other issues the COV feels are relevant.

The COV obtained data that showed that whereas overall funding levels for the NSF have been increasing substantially during the past 5 years (47%), appropriations to the MCB have increased only 18% and, even more problematic, appropriations to the GGS Cluster have increased only 8%, less than the rate of inflation. Moreover, Dr. Clutter informed us that it is current policy to increase both award amount and award time for the grants under consideration here and acknowledged that this would result in fewer awards.

The COV is profoundly concerned about the course of these events and believes that the seriousness of these issues requires immediate attention at all levels within NSF. While we find the new initiatives that have been

funded during the past few years to represent exciting new biology and provide the foundation for new avenues of investigation in many fields of research, the longer-term benefits of such initiatives will be lost without additional core funding for follow-up work.

C.5 NSF would appreciate your comments on how to improve the COV review process, format, and report template.

The COV believes that the process could be improved by:

1. **Numbering the questions in the COV template**

2. **Clarifying the meaning of a number of ambiguous questions, as noted in sections above**

3. **Providing more information about what is contained in each of the documents on the CD provided**

4. **Continued attention to the relevance of the template to the charge of the COVs is encouraged**

Issues related to COV 'charge':

To the extent that the issues contained in the COV 'charge' (below) are not covered elsewhere in this COV report, please comment on:

Identification of: emerging research opportunities, significant challenges within a field, or areas for growth or increased emphasis; factors that may represent barriers to progress within and among the fields represented by the Cluster, such as critical limitations in technology, methodology, or theory; and the unique role(s) that NSF plays in the area of Genetics and Genome Systems.

SIGNATURE BLOCK:

/S/ U. Goodenough

_____

For MCB Genes & Genome Systems Cluster COV
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