

# Division of Molecular & Cellular Biosciences

## 2011 Committee of Visitors

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### COV Member List

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#### COV Chair

Dr. Gloria Coruzzi  
New York University  
Field of Study:  
Systems Biology

Dr. Olga Danilevskaya  
Pioneer Hi-Bred  
Field of Study: Chromatin Remodeling

Dr. Jennifer Doudna  
University of California, Berkeley  
Field of Study: RNA Biochemistry and  
Structural Biology

Dr. Ernesto Freire  
Johns Hopkins University  
Field of Study: Protein Folding,  
Biophysics

Dr. Clark Lagarias  
University of California, Davis  
Field of Study: Photobiology and Plant  
Biochemistry

Dr. Cathy Lewis  
National Institute of General Medical  
Sciences  
Field of Study: Biophysics

Dr. Sabeeha Merchant  
University of California, Los Angeles  
Field of Study: Metal Homeostasis and  
Algal Genomics.

#### COV Co-Chair

Dr. Renato Aguilera  
University of Texas at El Paso  
Field of Study:  
Immunology, Eukaryotic Genetics

Dr. Mary Jo Ondrechen  
Northeastern University  
Field of Study: Computational  
Biophysics

Dr. James Siedow  
Duke University  
BIO Advisory Committee Member

Dr. Regina Stevens-Truss  
Kalamazoo College  
Field of Study: Signal Transduction,  
Proteomics

Dr. Linda Walling  
University of California, Riverside  
Field of Study: Plant Molecular Biology

Dr. Maria Elena Zavala  
California State University, Northridge  
Field of Study: Plant Cell Biology

# **Committee of Visitors Report on the Molecular and Cellular Biosciences Division of the BIO Directorate**

**March 23-25, 2011,**

## **Executive summary**

The NSF Division of Molecular and Cellular Biosciences (MCB) plays a strategic role in the BIO directorate by defining and driving key areas of research at the molecular, cellular and systems levels to identify mechanisms that regulate organisms and their responses to an ever-changing global environment. MCB's scope spans life's diversity from microbes to plants to animals, and its studies range in resolution from single molecules to whole genomes, from the subcellular to the organismal.

In the period covered in this COV report 2008-2010, the panel concluded that MCB has done a remarkable job of seeding and funding both intra- and interdisciplinary research that has led to advancements in scientific discovery, training, and innovations in science education, with relevance to societal and environmental demands. These scientific engines have been empowered by a high-functioning and interactive team of MCB division leaders, program directors and administrative staff, who blend an excellent mix of institutional vision/knowledge with a healthy influx of scientific expertise from rotating staff. This team has been adept at navigating a balance in demographics and funding of new investigators and underrepresented groups and was also responsive to the previous COVs recommendations.

### **Points of success for MCB in 2008-2010**

- Portfolio is diverse and MCB is funding outstanding science
  - Balance of traditional, single investigator vs. larger collaborative grants
  - Balance of hypothesis-driven and discovery-based science.
  - Balance of Signature projects: Arabidopsis 2010, Model Organisms,
- MCB has shown willingness to take scientific risk
  - Made novel efforts to encourage innovation and define new areas
  - Examples: "Sandpits", "Ideas Labs", and "Big Pitch"
- Enhanced interdisciplinary and interdivisional science funding
  - MCB with Physics, Mathematics, Computer Science and Chemistry,
- Education is well integrated with cutting-edge science
  - Example: Synthetic Biology and "Build a Yeast Genome"
- Enhanced funding of underrepresented groups
- Demographic distribution of grants was expanded - e.g. EPSCoR
- Responded effectively to previous COV recommendations in
  - Proposal review including broader impacts
  - Staff and PD morale and workload issues
  - Communication within the Division and BIO Directorate
- Personnel interactions were healthy and MCB staff displayed good morale
  - Includes interactive team of leaders, PDs, and Administrative staff
  - The COV was impressed by the relatively small number of MCB staff and their exceptional accomplishments.

**Challenges in 2011-2013.** The challenge for MCB in the coming cycle will be to advance innovative and transformative research, while maintaining the breadth and depth of its scientific portfolio. This will be increasingly difficult at a time of decreased budgets, and increased demand for solutions to environmental and societal issues.

- Upcoming NSF/MCB Challenges
  - Decreased NSF budget
  - Increased MCB grant applications
- MCB needs to remain competitive while maintaining and redefining focus/niche
  - Maintain a Portfolio balance between depth & breadth, and innovation
    - **Core Areas:** Balance investment in core areas with emerging and signature initiatives.
    - **Signature Initiatives:** Identify and support unique signature initiatives that have scientific focus and impact, yet are inclusive and serve a wide range of the scientific community (e.g. model organisms)
    - **New and Competitive Areas:** Enter new fields (e.g. synthetic biology, systems biology, etc) with a scientific focus on the NSF portfolio- the natural world
- Respond to changing societal and environmental needs
  - This is one of the unique roles of NSF and in particular of MCB.

To enable MCB to continue to thrive in its mission in 2011-2013, the COV identified important issues that, along with specific recommendations, are presented here in brief form and detailed in the body of the report.

### **Scientific Recommendations**

**Scientific Focus:** The COV was impressed with the scientific accomplishments and vision of MCB in expanding into new areas while maintaining a solid core. It is commendable that MCB has used innovative methods (e.g. Ideas Lab, Sandpit and Big Pitch) to explore and expand their research portfolio into new and emerging areas (e.g. Synthetic Biology and Systems Biology) including funding high-risk, high pay-off science. The panel did, however, express some concern about MCB potentially diluting its efforts rather than focusing on its uniqueness and strategic initiatives. The COV recognized MCB's role in catalyzing new and signature areas of inquiry that are transformative and focused, yet inclusive. An example of this is "Model Organisms", an MCB signature focus area that is inclusive across all life forms and develops a research community and associated resources.

**Biology at the Interface:** The COV was very encouraged by the interdisciplinary funding activities initiated between MCB and other divisions including Physics, Chemistry, Math, Computer Science, and Engineering. The COV commends these collaborations and activities and recommends that MCB continue to expand on these areas in the future.

**Balance of Small vs. Large Project Funding:** The COV recognizes the importance of MCB's funding of a diverse portfolio containing single investigator grants (with large and small budgets), as well as large multi-investigator grants. MCB is encouraged to

continually re-examine this mix to ensure an appropriate balance is maintained. It is also important to maintain a balance between hypothesis-driven and discovery-based, large-scale biology research.

### **Grant Administration:**

**Panel Reviews:** The COV found the Review Analyses to be extremely valuable documentation about the grant reviews and funding decisions. The COV recommends that a version (or portion) of these Review Analysis reports be rapidly communicated to PIs, especially in cases where panel summaries are positive and funding decisions are negative. This would help PIs understand how to amend for resubmission before the next proposal deadline.

**Ad Hoc Reviews:** The COV noted that the “return” on ad hoc reviews was low. There was also a serious concern for confidentiality of the grants sent to ad hocs who decline to review. It is recommended that only the title and project summary be sent to ad hocs as a pre-inquiry, along the lines of journal request to review. The ad hocs should also be required to formally acknowledge that the information is confidential before being allowed to download the grant. The COV noted that NSF grantees should be encouraged to serve the NSF by providing Ad hoc reviews or service on grant panels.

**Review Feedback Timing and Proposal Deadlines:** The COV panel noted that there was an improvement in turnaround time on funding decisions since the last COV, with 90% of the review of applications completed within 6 months. Nevertheless, for unfunded grants, this turnaround precludes PIs from meeting the next submission deadline. We recommend that MCB find a solution to this problem. This may include an earlier release of reviews or an extension of deadlines for resubmissions. The COV also recommends that the proposal submission deadlines be pushed forward a month, possible to Feb/Mar and Aug/Sept, so that grant submission and processing does not conflict with university and school holiday closings as they relate to family care issues.

**Internally Reviewed Proposals:** With the substantial increase in size of EAGER grants, we recommend that a minimum of two PDs review and approve the requests, in addition to sign-off by the DD.

### **Improving Educational/Societal Mission**

**Underrepresented Scientists:** The COV noted an increase in funding of minority scientists since the last COV. We would like to see a continued improvement in this direction. We also noted that RIG/CAA awards have been discontinued and are concerned about what funding mechanisms will replace these.

**Tracking of Trainees:** The previous COV recommended that NSF implement a tracking system for trainees, and this has not been implemented. The current COV concurs with this request.

**Broader Impacts:** The COV had ample discussion about Broader Impacts and expressed opinions that two types of broader participation should be recognized more fully: 1) PIs who participate in existing mechanisms to train/educate/mentor students in their research labs or for activities within their institution, and 2) PIs who create new vehicles to train and educate students. Both are valuable and valid. We recommend

metrics of success be included in the annual progress reports. We also note that the NSF *Highlights* were effective and that both scientific merit and broader impacts should be included in them. The panel also discussed that NSF might consider setting aside specific funding for grants for which the Broader Impacts was significant and a more compelling component compared to the Intellectual Merit.

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**MCB would like your advice about several questions related specifically to the Division:**

**1. What new opportunities in molecular and cellular biosciences should the Division address?** In addition to the emerging areas identified by the previous Committee of Visitors in 2008 that include systems biology, metagenomics, synthetic biology, protein disorder, epigenetics, the COV identified potential new areas of research/education for MCB consideration:

**Within Biology**

Phenomics: Genomes-to-Phenomes

Real-time Biology: Dynamic responses of molecules, cells, populations and systems

**Interdisciplinary**

Computational and Predictive Biology (with Mathematics and Computer Science)

Bio-inspired design of materials, processes, and machines (with Engineering)

**Response to Societal Needs**

Biology for Sustainability (e.g. Clean energy, oil spills)

**Infrastructure**

High-throughput phenotyping facilities

Real-time super high-resolution imaging

Cyber-enabled use of instrumentation

**Broader Impacts/Education**

Priming the stalled pipeline: A path from PhD to professor

Enlist professional assessment of broader impacts (e.g. quantitative metrics).

**2. How can the Division encourage interdisciplinary and integrative research in the cellular and molecular biosciences?**

**Comments:**

MCB should continue to promote interdisciplinary research and training among biology and the other disciplines including chemistry, math, computer science, physics, and engineering. More inter-directorate panels and program directors with associated budgets to create think tanks and working environments that inspire new innovative fertile ground should be implemented.

### **3. How can the Division assess the quality and impacts of science supported by the Division?**

#### **Comments:**

The evidence indicating that a new research area seeded by NSF funding is having a significant impact in science can be measured by a number of metrics including: 1) workshops and conference sessions at national and international meetings; 2) new investigators drawn to the field; 3) the number of grant applications in this research area; 4) the number of publications, citations and review articles; and 5) patents and industries' activity related to the field.

### **4. How do we, as an organization that supports fundamental molecular and cellular research, promote issue-inspired science, such as research that addresses societal needs?**

#### **Comments:**

Because MCB's mission encompasses organismal responses to changes in their natural environment, its research portfolio should be especially attuned to and responsive to global and societal issues related to these changes. In addition to the RAPID mechanism, we are suggesting that supplements to existing research that specifically address the issue could also be funded.

### **COMMITTEE CLOSING COMMENTS:**

**COV Committee composition, work, format and MCB staff:** The COV was composed of members representing a broad range of expertise and perspectives, including members from academe (research and educational institutions), other granting institutions (NIH), and industry. We appreciate this broad perspective that was important for our collective assessment. The COV performed much of its work prior to the NSF on-site panel meeting using the valuable documents provided in the e-COV by the MCB staff (Self-study and Appendices) and an MCB-specific Wiki. We highly recommend this approach for future COV committees. We also highly commend the MCB staff that enabled this activity by implementing a Wiki pre-meeting online training workshop, as well hands-on assistance during the actual meeting at NSF. At the NSF we also heard additional information in presentations from the DD (Steve Howell), the DDD (Parag Chitnis) as well as during interviews. We also conducted panel discussions/Q&A with: PDs from MCB, PDs from other divisions (Physics, Math, Computation, Chemistry, & Engineering, Social Science), conducted meetings with MCB Admin Staff, and the Division Management Team. We also met in an Executive Q & A Session with the Acting AD (Joann Roskoski), Acting EO (Joann Tornow), and the DD, DDD, as named above.

**Closing remarks:** The COV thanks the MCB leadership and administrative team for their time, input and hard work on behalf of the scientific community and for the valuable time they spent with the COV. We especially thank and applaud MCB staff members Alison Beason and Kimberly Watson, for providing the documentation, serving as scribes during the meeting, and enabling this Wiki approach to the COV report. Their professionalism and expertise was truly superb. We also thank and acknowledge Dr. Parag Chitnis (DDD) for providing data, responding to queries and for generally enabling the COV the freedom to conduct the meeting according to our plan. We believe that this

COV report acknowledges the significant successes of MCB in 2008-10, and hope that our recommendations inspire additional directions in the coming 2011-13 cycle.

## **DIVISION OF MOLECULAR AND CELLULAR BIOSCIENCES COMMITTEES OF VISITORS (COVs)**

**Date of COV:**

March 23-25, 2011

**Division:**

Molecular & Cellular Biosciences

**Directorate:**

Biological Sciences

**Number of actions reviewed:**

**Awards:** 37

**Declinations:** 157

**Total number of actions within Program/Cluster/Division during period under review:**

**Awards:** 849

**Declinations:** 3,592

**Manner in which reviewed actions were selected:**

A stratified random sampling method was used to select a set of proposals for analyzing the review process. For quantitative measures (such as the percentage of review analyses addressing both criteria), 188 proposals are predicted to provide a 7% margin of error. The number of proposals in the sample set was determined by the proportion of proposals (Fiscal Year and Internally Reviewed Proposals) in the original set. Selection was determined by an Excel random selecting program. A total number of 180 proposals that were reviewed externally and 8 proposals that were reviewed internally are included in the sample for examination by the COV.

# PART A.

## INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, declinations, and withdrawals) that were *completed within the past three fiscal years*. Provide comments for *each* program being reviewed and for those questions that are relevant to the program under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

### A.1 Questions about the quality and effectiveness of the program's use of merit review process.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p><b>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</b></p> <p><b>Method of Analysis of e-jackets:</b> We examined in detail about 50/211 (~23%) randomized proposals provided at the eCOV site. E-Jackets selected for detailed examination were not chosen randomly, but chosen based on i) familiarity of the committee member with research area, ii) effort to read documentation for situations where decisions did not match panel recommendations, and iii) effort to examine different types of project funding (e.g. conference, PUI, EAGER, ARRA). The 50 e-jackets reviewed in detail include: ARRA (7), CAREER (6), Collaborative (5), EAGER (5), PUI (4), Conference (3), RIG (2), 2010 (2), RAPID (1), SGER (1), Other (19).</p> <p><b>Comment: Proposals reviewed in Panel:</b> For proposals reviewed in panel, we noted that with one exception, all proposals were reviewed by at least 2 panelists and between 2 to 4 reviewers. This seems appropriate. In some cases, we noted that very few external reviews were returned to NSF, despite a number of requests by PDs for reviews. This suggests that program staff members are conscientious about soliciting external reviews, but that there is an issue with compliance. The conference grants are not reviewed in panel and nor are the EAGER/RAPID proposals. Our review and recommendation for these internally funded grants is below.</p>	<p><b>Yes</b></p>

**Comment: Internally Reviewed Awards:**

Given that the amount of funding for EAGER grants is substantial (\$300,000), we recommend that additional mechanisms be put into place to ensure objectivity. Of the 42 Internally Reviewed Awards at MCB in 08-10 (27 EAGERS/11 RAPIDS/4 SGERs), we examined 7 in detail (5 EAGERS, 1 SGER, 1 RAPID) (16%), 6 of which were funded. The rationale for EAGER-type funding as outlined in the Review Analyses varied greatly in their structure and rationale for award. In some cases, EAGERS were the result of previously declined grants, for which specific sub-aims or preliminary data were supported. In other cases, there was no documentation of how the award application was solicited. In most cases, the documentation indicated that more than one PD had reviewed the application and made the decision. However, in some cases, the award decision was made by a single PD, without an indication of another internal review. The COV recommends that additional mechanisms be put in place to ensure that EAGERS are reviewed at minimum by two separate PDs.

**Comments regarding Ad hocs**

**Ad hocs and Panel Memory:** The COV acknowledged that Ad Hocs are valuable because they bring in experts that may not necessarily be on the panel. Ad hocs can potentially serve a role for panel "memory" and should be enlisted by PDs to re-review re-submissions of revised grants, as panel memberships change every panel.

**Ad hocs and confidentiality:** The confidentiality of the ad hoc reviewers should be thought about. The panel noted that Ad hocs should not be given access to the full proposal unless they have agreed to review. They should only be given access to the abstract until and unless they agree to review. This is the protocol that journals follow. An alternate proposal is to at minimum require Ad hocs to click on a box that acknowledges that they agree to confidentiality before they are allowed to download the proposal.

**Question re return rate on ad hoc reviews:** Are NSF grantees more likely to respond to requests for reviews compared to non-grantees? If there is no difference in return from grantees vs. non-grantees, there ought to be a mechanism to ensure that NSF grantees provide service to the NSF as an Ad hoc reviewer or as a grant panel member. Are NSF grantees more likely to serve on panels? Or are they more frequently invited to serve?

**2. Are both merit review criteria addressed**

**Yes**

<p><b>a) In individual reviews?</b></p> <p><b>b) In panel summaries?</b></p> <p><b>c) In Program Officer review analyses?</b></p> <p><b>Comments:</b>  The reviewers are provided with a template and it is clear that most reviewers and panelists indeed address both review criteria. The self-study document (Tables 4-7) substantiates the perception that both review criteria are used effectively by reviewers. In general however, the Intellectual Merit criteria are addressed in greater depth than the Broader Impacts. There is also some variation in the criteria used for assessing Broader Impacts. It may be the case that Broader Impacts can raise the priority level of a project for certain types of projects, such as those from PUI. The PDs have the flexibility to weight the Broader Impacts accordingly.</p> <p><b>Recommendation to enhance review of Broader Impacts:</b>  We recommend that more substantive comments might be obtained from reviewers if a separate score is recorded for Broader Impact</p> <p><b>Recommendation re Broader Impact evaluation:</b>  The COV had ample discussion about Broader Impacts and expressed two “majority” opinions that two types of broader participation should be recognized as valid: 1) PIs who participate in existing mechanisms to train/educate/mentor students in activities within their institution and/or in their research labs, and 2) PIs who create new vehicles to train and educate students. Both mechanisms are valuable and valid.</p> <p><b>Consideration for Broader Impact funding:</b>  The panel discussed that NSF might set aside specific funding for grants for which the Broader Impacts was significant and a more compelling component compared to the Intellectual Merit.</p>	
<p><b>3. Do the individual reviewers provide substantive comments to explain their assessment of the proposals?</b></p> <p><b>Comments:</b>  The ad hoc reviewers as well as the panelists appear to be very conscientious in general. All proposals had several substantive reviews, as quantified in Table 10 of the self-study. There may well be one or more reviews that are less substantive but the remainder was adequate for understanding the basis of the decision and, more importantly, for understanding what needs to happen to turn the proposal into a successful application at the next submission. All the reviews were professional.</p>	<p><b>Yes</b></p>

<p><b>Recommendation: Separate entries for Strengths vs. Weakness.</b> The reviews should have strengths and weaknesses separated within each section (e.g. for Intellectual Merit and Broader Impacts) by providing a template that requires each to be included as in the panel summaries. This would enhance the review process.</p>	
<p><b>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</b></p> <p><b>Comments:</b> The panel summaries give an overall summary of the two main parts of the panel review: 1. Intellectual Merit, and 2. Broader Impacts. That the panel summaries meet both criteria is quantified in the self-study (Tables 6,7, 9 and 10). In general, the Panel Summaries tended to be briefer for the grants rated Medium Priority (MP) and Low Priority (LP), and are much less detailed about outlying opinions compared to the Review Analysis. As the Panel Summary is really the only mechanism by which a PI gets detailed insight into why a decision is made to award or decline, for grants rated MP or LP, the Panel Summaries should possibly include a section which gives guidance to the PI as to what needs to be done to improve the resubmission.</p> <p><b>Recommendation:</b> The "Scribe" function was implemented in the fiscal years of this review process and was looked upon positively by the COV. The panel noted however that low priority proposal panel summaries were not very substantive and informative for the PI. The High Priority proposals had more constructive feedback. The panel summaries for low priority proposals need to be crafted to provide better guidance for the PIs. Perhaps a summarized version of the review analysis could be sent back to the PI because they are were exceptional and gave excellent insight for the funding decision judgment. Scribes should be instructed on these points to improve panel summaries to be more prescriptive.</p>	<p><b>Yes</b></p>
<p><b>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</b> (Note: Documentation in jacket usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.)</p> <p><b>Comment:</b> We were very impressed with the documentation provided for each proposal. The e-jackets are very helpful for an outsider to understand the review process. The panel summaries are detailed, well-</p>	<p><b>Yes</b></p>

organized, and most importantly, make an effort to explain any outlying comments. The self-study substantiates this opinion (Table 11). Anecdotally, it appears that some Low Priority proposals may not receive as much detailed reporting as the unfunded Medium and High Priority applications.

**ARRA Proposals:**

During FY 2009, NSF permitted reversal of a declined decision for funding through ARRA for proposals declined after October 1, 2008. (NOTE: This question does not apply to programs for which the reversal decline option was not used.)

**Comment:**

Table 30 summarizing ARRA funding is shown in the self-study report. We examined the e-jackets for 7 randomly selected ARRA awards (out of 112) in detail to address this question. The Review Analyses of the ARRA awards were *exceptional* in their uniformity and detail of summarizing the panel scores (e.g. E,V), panel recommendations (e.g. HP), and in reporting the rationale for final funding decision.

**MCB posed Question: i)** Were the reversals of the decision to decline based on both the high quality of the reviews received on the initial submission and the lack of available funding at the time the origin was made? (Rated "Very Good or above" or the functional equivalent by review panels.)

**Response:**

Of the six ARRA selected for detailed review, one was a reversal of a previous declination, for which the previous panel rated the proposal (2E, 2E/V,V, G) and rated High Priority but the award was not made. The ARRA award was made in response to outstanding progress since the original submission including the publication of one paper and additional preliminary results. The second reconsideration for an ARRA award was a resubmission of a CAREER award, where progress since the previous submission was excellent including 2 significant publications. Four of 6 ARRA awards were straightforward E/V scores and HP, while three that also had E, V and G scores were in the MP range.

**MCB Posed question ii)** Is documentation provided, including a revised Review Analysis, to support the award decisions?

**Response:**

The one ARRA award in our sample of 7 e-jackets that was a reversal of a previous decision, included email communications to the PI about the reversal of funding decision. The Review Analysis however, did

<p>not indicate that it was a reversal of a previous decline explicitly. However, it did note that recommendation for funding was made based on significant progress since submission of the original grant.”</p> <p><b>Recommendation:</b> The COV <b>strongly</b> encourages the division to include some kind of summary (with the detail and "real" explanations, i.e. Review Analysis) to the PI. This is especially important for decline decisions to help in the resubmission.</p>	
<p><b>6. Does the documentation to PI provide the rationale for the award/decline decision?</b> (Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written or telephoned with diary note in jacket) of the basis for a declination.)</p> <p><b>Comments:</b> The Panel Summaries are thorough in reporting the panel review of grants. The Review Analyses generated by the PDs in general do an excellent job of summarizing the review of the panel, and explaining the rationale for PD funding decision. However, in cases where the PD funding decision deviates substantially from the Panel Summary, the communication of this rationale to the PI was not always detailed in written documents. Most of the email communications to the PI did not include substantive comments about the funding decision but were related to administrative protocols.</p> <p><b>Recommendation re communication of Funding Decision:</b> As mentioned in the previous COV report, we recommend that a reporting structure to PIs be implemented to give guidance as to i) why the NSF funding decisions deviated from panel recommendations and ii) to report to the PI what needs to be done to get the work funded or guidance to the PI as to whether the work will ever get funded.</p>	<p><b>Yes , but with exceptions</b></p>
<p><b>7. Is the time to decision appropriate?</b></p> <p><b>MCB Note:</b> Time to Decision \--NSF Annual Performance Goal: <b>For 70 percent of proposals, inform applicants about funding decisions within six months of proposal receipt or deadline or target date, whichever is later.</b> The date of Division Director concurrence is used in determining the time to decision. Once the Division Director concurs, applicants may be informed that their proposals have been declined or recommended for funding. The NSF-wide goal of 70 percent recognizes that the time to decision is appropriately greater than six months for some programs or some</p>	<p><b>Yes</b></p>

individual proposals.

**Comments:**

For MCB, the data provided indicates that the time to decision is on average around 5 months (Fig. 3 and Table 12, of Self Study) and that 90% of the proposals fall within a 6-month "dwell time". This is appropriate, except that it leaves little opportunity for PIs who need to make only minor revisions to re-submit for the next round of review. For renewal applications, this could be problematic in the sense of lapse of funding to support personnel.

**Comment on January Deadlines and Family issues:**

We have heard anecdotally from some PIs that an early January and early July submission deadlines are not "family friendly" and may adversely impact PIs with family obligations over the holidays -- when many daycare centers are on holiday as well. **Suggestion: Change deadline to mid-late January or early February.** A corresponding change to late July or early Aug deadline would also be more convenient for PIs who teach on a quarter system.

**Recommendation:**

We recommend that both awards and declinations should get the **reviews** in time for the next cycle. Maybe the division should extend the due date of the proposals that was given late notice of their proposal status. MCB is doing a great job in the turnaround rate, but could always improve the turnaround rate.

**8. Additional Comments**

***MCB question:***

***a) Additional comments on the quality and effectiveness of the program's use of merit review process.***

**Standardization of Review Analysis:** In assessing the programs use of merit review- the Self Study was truly an essential and exceptional document for the COV. In the individual e-jackets, the Review Analysis was a truly essential document to assess the rationale for the award decision. It is the one place that all the information is summarized and the rationale for the funding decision is made. We did however find a wide discrepancy in the format of the Review Analysis used by PDs and the level of details summarized therein. We feel it would be helpful to tighten up the format for the Review Analysis report to enable NSF DD and CoV members to more readily compare between panel decisions and funding outcomes. One report summarized the status in a concise format that should be the gold standard for Review Analysis. It is listed below along with several suggested sections to add.

**EXAMPLE OF A STANDARDIZED REVIEW ANALYSIS:**

PI Name/number: A.N.Other/0999999

Proposal Title: My Latest Research Proposal

**Analysis:**

Results of prior support: One manuscript

Conflicts of Interests: None

Other Support: Current NSF

Co reviews: None

Panelist Scores: V, V/G, G, G, G

Ad Hoc Ratings:

Panel Rating: Medium priority

PD Funding Decision: Decline

Does PD recommendation align with Panel Summary? Y/N

If no, please provide rationale for funding decision:

(E.g. Programmatic needs, Underrepresented group, Geography, etc.)

**MCB Question:**

**b) To what extent does the documentation in the jacket or otherwise available provide the rationale for use of ARRA funding?**

**Comment:**

In the overall ARRA funding by this panel, 112 Awards, 61 were new investigator, 13 Career, 7 RUI, 10 Climate Change, and 15 Energy related (See Table 30 of Self-Study). In the 6 e-jackets for ARRAs made available to the COV, 1 was New Investigator, 1 was CAREER, but this was not highlighted as contributing to the decision. To make it crystal clear to the Federal Government, perhaps these 112 Review Analyses should be amended to add a special section on the reason for ARRA funding. For example, there was no explicit mention of jobs created as they relate to specific proposals, or target areas (energy, climate change) and this could be a strong case for ARRA funding.

**Miscellaneous COV comments:**

**New funding areas:** Of the subsample selected, we noted significant funding in new and emerging areas of Systems Biology, Synthetic Biology, and Biophysics. We note that a number of Biophysics awards were made to women, which is notable.

**Recommendations for future COVs documents:**

1. Organization of e-jacket list: Organizing excel list of e-Jacket list into Grant types (e.g. CAREER, ARRA, etc) would be helpful.
2. Funding Decisions: Identify list of proposals where PD funding decisions deviate from panel recommendations.
3. Renewal Applications: It would be nice to have statistics on renewal application funding frequencies.
4. Reviewer Stats: Since NSF collects so much information on reviewers, would it be possible to obtain statistics on the reviews as a function of gender, PUI vs. research PI, under-represented minority, etc -- return frequency, score, etc.

**A.2 Questions concerning the selection of reviewers.**

<b>SELECTION OF REVIEWERS</b>	<b>YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b>
<p><b>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</b></p> <p><b>Comments:</b> <b>Reviewer qualifications.</b> We analyzed a subset of the 200+ proposals provided to us. The 27 proposals audited averaged 4.8 reviewers per proposal (ad hocs plus those on the panel who reviewed the proposal). For most proposals, a majority of the reviewers were judged by us to be highly qualified to review them. The majority of proposals also had 1 or 2 reviewers whom were seen as either moderately or not very qualified to review the proposal on cursory examination by the COV. In a few cases (15%), these reviewers equaled or even outnumbered the highly qualified reviewers. While these latter proposals were too few in number (4) to make any statistical case for, all were Declined.</p> <p><b>Foreign reviewers.</b> A few proposals were reviewed by scientists from outside the U.S. This was a concern expressed by the previous COV), but they were limited in number and did not strike the COV as a much of a problem during the period currently being reviewed.</p>	<p><b>YES (mostly but not always)</b></p>
<p><b>2. Did the program use reviewers balanced with respect to characteristics such as geography, type of institution, and underrepresented groups?</b></p> <p><b>Comments:</b> <b>Reviewer demographics.</b> According to the Self Study Tables 14-17, 26-27% of reviewers report demographic information each year. Thus it is difficult to ascertain whether the reviewer pool is balanced. Of</p>	<p><b>Tentative yes, but better data are needed</b></p>

the reviewers reporting demographic information, according to Tables 13-18, 31-33% are female and 10-12% are underrepresented minorities. It also appears that the reviewer pool has representation from undergraduate and masters institutions, although the number from master's institutions is low. While all 50 states are represented in the reviewer pool, the EPSCoR states tend to be less well represented, perhaps a reflection of the distribution of available reviewers with appropriate expertise.

**Lack of sufficient demographic data.** The small fraction of reviewers returning demographic information is troubling. Perhaps MCB could provide a brief statement to reviewers, reminding reviewers of the NSF's congressional mandate to support scientific research across the entire country. Therefore, while submission of demographic information is voluntary, it is very helpful to the NSF in insuring the fulfillment of its congressional mandate.

**Question about gender bias in reviewer selection.** It is difficult to determine with the given information whether reviewers are balanced across all proposer demographic groups. For example, ideally, the distribution of male and female reviewers should be overall the same for proposals written by males as for proposals written by females. Examination of a small sample of jackets suggests that this may be the case, but the sample is too small to determine with certainty. It would be helpful to have some data about this.

**Please continue to improve diversity of reviewer pool.** There is a need to continue to be vigilant to improve representation of women and minorities in the reviewer pool. We also note particularly low representation of reviewers from Master's institutions.

**3. Did the program recognize and resolve conflicts of interest when appropriate?** **Yes**

**Comments:**

A scan through a subset of the jackets available to the COV turned up examples of identified conflicts of interest with both ad hoc reviewers and Panel members. Within the jackets, reviews written by anyone with an identified conflict of interest are listed as rating "C". Presumably these reviews are not considered.

**4. Additional comments on reviewer selection:**

In general, there appears to be wide variation in the number and quality of reviews. Some reviewers take the time to write many details, while others make only a few general statements. There is also sometimes disparity between the overall rating and the comments.

**Recommendation:** We recommend that reviewers be asked explicitly to identify the strengths and weaknesses of both the intellectual merit and broader impacts. Specifically, we recommend that the review form say "Strengths" and "Weaknesses" in separate lines under both categories.

### A.3 Questions concerning the resulting portfolio of awards under review.

<p style="text-align: center;"><b>RESULTING PORTFOLIO OF AWARDS</b></p>	<p style="text-align: center;"><b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b></p>
<p><b>1. Overall quality of the research and/or education projects supported by the program.</b></p> <p><b>Comments:</b></p> <p>We briefly discuss the highlights of the funding portfolio here, since they have been discussed in previous sections. The overall quality of both the research and educational projects supported by MCB is excellent. An important strength of the program is its flexibility with regard to funding decisions. In addition, MCB funds investigators across a broad range of institutions and geographic locations. As noted in previous sections, a potential concern is the lack of peer review of some types of grants (EAGER). In these cases, the proposals should be subject to consideration and approval by at least two Program Directors. Alternatively, an online review process similar to that used by the NIH Pioneer Award program could be adopted, to enable rapid peer review of these applications.</p> <p>ARRA support appears to have been distributed to a variety of different kinds of projects, including high-risk or exciting projects that would otherwise not have been funded due to pay-line cutoffs. In addition, many CAREER and other types of awards were provided to junior investigators in response to the influx of ARRA funds.</p>	<p style="text-align: center;"><b>Appropriate</b></p>
<p><b>2. Does the program portfolio promote the integration of research and education?</b></p> <p><b>Comments:</b></p> <p>According to Table 21 of the Self-Study, roughly 25% of overall proposals and supplement requests were granted annually during the review period. This reflects a fairly high success rate for applicants, especially compared to most divisions of NIH. Notably, virtually all supplement requests were awarded. Proposals require a detailed description of the way in which teaching is integral to the proposed research project. While this encourages investigators to create a teaching plan, it also can force them to extend themselves in ways that may not be most beneficial to the project and/or mentoring goals. The CoV noted that both the simple exposure of students to research experiences, and more elaborate efforts in community outreach, could be appropriate mechanisms of incorporating education into research projects.</p>	<p style="text-align: center;"><b>Appropriate</b></p>

Also, the number of RUI proposals was markedly lower in FY2010 compared to the previous two years (45 vs. 70+), yet the same number of awards was granted. It will be worth following these numbers in future years to determine whether this is a temporary aberration or whether there are issues with access, program guidance, etc.

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

**Appropriate**

**Comments:**

Most awards appear to be funded at a level within 5% of the requested amount. Awards average \$140K/year (direct costs) for 3 years, although there was a broad range of award sizes reflecting projects of different scale (Fig. 5, Self-Study). Overall this appears suitable for the projects proposed. The CoV noted that the average funding level limits the kinds of projects that can be reasonably supported, and as costs continue to increase, the scope of research that can be conducted with such awards is consistently contracting. Also, geographic differences in personnel costs affect projects unequally.

**Recommendation: Balance of Small vs. Large Project Funding:**

The COV recognizes the importance of MCB's funding of a diverse portfolio containing single investigator grants (with large and small budgets), as well as large multi-investigator grants. MCB is encouraged to continually re-examine this mix to ensure an appropriate balance is maintained. It is also important to maintain a balance between hypothesis-driven and large-scale biology/discovery-based research.

**4. Does the overall program portfolio (including ARRA funded awards) have an appropriate balance of innovative/potentially transformative projects?**

**Appropriate**

ARRA Specific Question: Does the ARRA funded portfolio have an appropriate balance of innovative/potentially transformative projects?

**Comments:**

The highlighted research during the review period is exciting (see Highlights Document (H) in COV documents), and it would be good to continue encouraging high risk/high payoff proposals. Ongoing efforts that MCB is making to stimulate innovative thinking and scientific discovery are commendable and should be continued, pending evaluation of the success of these mechanisms.

<p><b>5. Does the program portfolio have an appropriate balance of Inter- and Multi- disciplinary projects?</b></p> <p><b>Comments:</b> According to Tables 22-24 of the Self-Study, both inter- and multi-disciplinary projects increased in numbers during the review period, perhaps reflecting an overall trend towards more multi-disciplinary research nationwide. This seems appropriate and should be encouraged, while guarding against a perception that projects must include multiple disciplines to be funded. NSF is uniquely positioned to support research at the interface of fields that haven't traditionally interacted extensively, such as physics or math and cell biology.</p> <p><b>Biology at the Interface:</b> The COV was very encouraged by the interdisciplinary funding activities initiated between MCB and other divisions including Physics, Chemistry, Math, Computer Science, and Engineering. The COV commends these collaborations and activities and recommends that MCB continue to expand on these in the future.</p>	<p><b>Appropriate</b></p>
<p><b>6. Does the program portfolio have an appropriate balance considering, for example, award size, single and multiple investigator awards, or other characteristics as appropriate for the program?</b></p> <p><b>Comments:</b> Most - or in FY 2009, all - selected proposals shown in Table 28 of the Self-study included a single investigator; it's not clear how this relates to the numbers of interdisciplinary projects discussed in the previous question. The implication is that more investigators are conducting interdisciplinary research without requiring formal co-application for funding with another PI.</p> <p><b>Comments/Observation:</b> The COV endorsed the fact that MCB funds small single and large single investigator grants and collaborative grants. This mix of funding is important to drive science at these different scales. An appropriate balance of the portfolio between these different funding levels is essential should be maintained.</p>	<p><b>Appropriate</b></p>
<p><b>7. Does the program portfolio have an appropriate balance of Awards to new investigators?</b></p> <p><b>Comments:</b> In section I of MCB Annual Reports (Item 1, of the Documents provided in e-COV) the percentage of awards to new investigators for the past three years (08-10) ranged from 9-20% with the higher rate</p>	<p><b>APPROPRIATE</b></p>

awarded in 2009. The spike in funding success in 2009 was mostly due to the influx of funds from ARRA, which resulted in an increase of 112 awards during that period. It should be noted that the increased success rate was also reflected in the "all investigator types" categories (~21%). During the past year, the success rate for new investigators was 12% (Table 29 of Self Study) while the percent for all investigators was 15%. The funding rate was slightly lower for new investigators and this was also noted in the 2008 COV report.

**Recommendation:** The COV would like to see that the rate of funding for new investigators or early career investigators be increased to a level at par with the rate for all investigators (an increase of 3-5%).

**MCB Posed ARRA-Specific Question:** Does the ARRA funded portfolio have an appropriate balance of awards to new investigators?

**MCB NOTE:** A new investigator, is defined as an individual who has not served as the PI or co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or postdoctoral fellowships, research planning grants, or conferences, symposia & workshop grants.)

**Comments:**

ARRA funds resulted in an additional 112 awards and resulted in the funding of new initiatives promoted by the administration- 10 in the area of Climate Change and 15 in the area of Energy. The biggest impact of ARRA funding was in the funding of new PIs (61) and resulted in a higher funding rate in this category from ~10-12% (2008 and 2010) to 17% in 2009. ARRA support also resulted in the funding of a large number of post-docs (113) and graduate students (370) in funded projects.

**8. Does the program portfolio have an appropriate balance of: Geographical distribution of Principal Investigators?**

**APPROPRIATE**

**Comments:**

As detailed in Fig. 8 of the Self-study, the geographical distribution of awards for the past three years has been relatively constant and it is fairly broad. However, it should be noted, that some states like North Dakota and West Virginia did not receive any awards during that period. Overall, it appears that the most populous states receive the higher number of awards (CA, NY and TX).

COV encourages PDs to visit states/universities with low representation to encourage proposal submissions.

<p><b>9. Does the program portfolio have an appropriate balance of Institutional types?</b></p> <p><b>Comments:</b>  Although the proportion of award types has remained relatively constant in the Doctorate and Research Intensive Institutions categories (~80% of total awards), there was a significant increase in the Business, State &amp; Local, Foreign, Other category in 2010. This category more than doubled from 2008 (14) to 2010 (40) but there was no rationale provided for this unusual increase. There was no information provided to explain the reason(s) for this increase.</p>	<p><b>APPROPRIATE</b></p>
<p><b>10. Does the program portfolio have an appropriate balance: Across disciplines and sub disciplines of the activity?</b></p> <p><b>Comments:</b>  The PDs are encouraged to diversify their grant portfolios and the extensive documentation provided to the COV indicates that indeed they are making good decisions in this regard. A large number of highly meritorious proposals were described in the Annual Reports, Leading Edge and Appendices supplied in the "O" section of the e-COV documents. Document sections that document the large variety of funded projects across several disciplines.</p>	<p><b>APPROPRIATE</b></p>
<p><b>11. Does the program portfolio have appropriate participation of underrepresented groups?</b></p> <p><b>Comments:</b>  The percentage of awards to Minority PIs from 2005-07 was ~26% but this percentage decreased in 2010 to ~17%. As may be expected due to the influx of ARRA funding, the highest percentage of awards (~24%) during the period under review to minority PIs was seen in 2009 (data provided in Table 32 of Self Study). Although the number of proposals from MSIs was relatively low, the percentage of awards to these institutions was fairly high in 2009 and 2008 (&gt;18%; see Table 32). The funding rate for minority investigators from 2008-2010 was actually higher (~24%) than for all PIs (~17%). It is interesting to note that the Cellular cluster had a significantly lower funding rate to Minorities than the other two clusters. Compare for example, funding rates of &gt;23% in the Biomolecular and Genes and Genomes clusters to 13-16% (2008 and 2010) the Cellular cluster (data from Section I). Female PIs represented &gt;16% of awards from 2008-10 (in all clusters) which in some cases was a higher percentage than awards to all PIs. PDs have also made a concerted effort to provide grant workshops and attended several scientific conferences to encourage broader participation by underrepresented groups.</p>	<p><b>APPROPRIATE</b></p>

These outreach activities have been more extensive and aggressive than in previous years and appear to have resulted as a result of prior COV recommendations. The MCB should be commended for these outreach efforts.

**Observation:** The COV noticed a significant difference in rate of funding to new, CAREER investigators (8.3% in 2010) and minority investigators (~9.9% in 2010) in the Cell cluster in comparison to the other clusters (data from I section). This should be an area for self analysis in coming years.

**Comments:** While at the current COV meeting, we were informed that the RIG-CAA program is going to be phased out in 2012. We were also notified that the program would be replaced with a "better" program and that there is a working group working on this issue. A recommendation was provided to the Division Directors and PDs that stakeholders from the minority research community be invited to such working groups. It may also be a good idea to invite Program Directors from the NIGMS MORE Division (Drs. Zlotnik, Rivera-Rentas, and Drew for example) to participate in such discussions and provide input as they have experience with targeted grant mechanisms (SCORE SC-1, SC-2, and SC-3).

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

**Comments:**

According to the Self Study report, over the last two years the topics relevant to national concerns included: (1) Understanding Complex Biological Systems, (2) Advanced Networking and High-End Computing, and (3) the National Nanotechnology Initiative. The majority of grants funded by MCB fell into one of those categories. According to the Strategic Plan, Budget and Performance report, "NSF oversees about 35,000 active awards directly supporting more than 175,000 people- including teachers, students and researchers at every education level and across all disciplines in science and engineering."

The Experimental Program to Stimulate Competitive Research (**EPSCoR**), which is a joint program of NSF and several U.S. states and states, aims to promote scientific development in states that do not generally receive a large number of federal grants such as West Virginia and Hawaii. Recent NSF awards to the aforementioned states are expected to improve research infrastructure, expand research efforts, and advance the economy. There are a large number of innovative education and research activities that the NSF supports that have had a profound impact on institutions and states and these

<p>initiatives should be continued and expanded.</p>	
<p><b>13. Additional comments on the quality of the projects or the balance of the portfolio:</b></p> <p><b>Comments:</b> The COV commends the MCB for the high quality of projects and for the balance of large, small and collaborative projects in its portfolio. More detail on the quality of the proposal is provided in various sections of this report.</p> <p><b>ARRA Specific Comments:</b> Additional comments regarding the portfolio of ARRA awards addressing the NSF or program-specific priorities for ARRA funding?</p> <p>As mentioned earlier, ARRA funds resulted in a significant increase of awards and the funding of new initiatives promoted by the administration. The biggest impact of ARRA funding was in the funding of new PIs and resulted in a higher funding rate in this category. The grants that were awarded appear to be in the areas of highest priority to the NSF and the administration.</p>	<p>APPROPRIATE</p>

#### **A.4 Management of the program under review**

##### **1. Management of Program Under Review**

**Comments:**

During the FY 2008-10, there were large changes to the staffing within MCB. The balance of permanent and rotating PDs approached the desired 1:1 ratio. Interviews with administrative staff and PDs indicated that while workloads remain high, staff morale has vastly improved. This appears to be due to the excellent leadership that is being provided by the current DD (Steve Howell) and DDD (Parag Chitnis). In addition, PDs indicated that there is now training for the rotating PDs that allow a more rapid adaptation to the NSF culture.

Significant steps to improve administrative and scientific staff morale and professional development were put in place and are outlined in the Update to the Response to the 2008 COV Report. BIO-wide and Divisional social activities and division-wide retreats have been implemented to facilitate better communication and enhance morale. Administrative staff has been assigned more analytical tasks that take advantage of their skill sets. MCB has a number of certificates of appreciation and time-off and financial awards to acknowledge staff talents, accomplishment and dedication. These changes have clearly impacted the morale of staff.

With the reorganization of MCB, the grant workload was significantly reduced per staff member and PDs. Although this resulted in a decrease the grant-related aspect of workloads, it does not appear that staff or PD workload has declined. PDs participate in a large number of work groups (Self-study. Table 2); PDs indicated that these time commitments are often substantial investments of their time. It appears that PDs are involved in outreach efforts; although time allotted to these activities may still be constrained by other administrative activities.

Based on staff interviews, it appears that NSF is committed to continual improvement of the eJacket working environment (although at time, progress for electronic data management is perceived as slower than desired). One current limitation is the inability of eJacket to communicate with PARs (the system that is used for reviewer assignments).

**Recommendations:**

(1) NSF should focus on getting PARs functions incorporated into the eJacket environment or find a way for PARs to communicate with eJacket.

(2) MCB and the BIO directorate should continue its excellent progress in improving the morale and working environment of its administrative staff and PDs. There has been remarkable progress on this front.

(3) MCB should continue to evaluate workload of PDs and administrative staff. The 2011 COV was impressed by the relatively small number of staff, and their exceptional accomplishments.

(4) MCB should investigate if there is salary disparity for the administrative staff in MCB and in other directorates.

**2. Responsiveness of the program to emerging research and education opportunities.**

**Comments:**

The Division provided four resources to enable the COV to identify its responsiveness to emerging research and education opportunities. These included documents that highlighted important discoveries funded by the Division, press releases on high profile papers, the 2008 annual reports for the clusters of MCB, and Cluster portfolio analyses. In addition, the COV had access to over 230 randomly selected grants, as well as 13 additional ARRA and SGER/EAGER grants. In addition, a number of documents were provided in the "O" Appendices.

Each of the clusters within MCB supports cutting edge research and potential transformational studies in a diverse research areas. The balance of these areas of research has not significantly changed significantly in the past three years. The role of SGER grants were not directly addressed in the 2008 annual reports. There was some unevenness in the quality of annual reports from the clusters. The SGER grants (2008)

and EAGER/RAPIDS grants (2009-2010) provided the Division a flexible and responsive mechanism to fund high-risk, transformative and urgent research projects. "Leading edge" retreats, workshops and other focused activities enabled the identification emerging areas of research within the MCB and the BIO Directorate. Also, MCB has demonstrated its ability to respond rapidly to emergency situations via RAPID grants that do not need to be reviewed by regular panels. An example is the 1059170 grant that was granted in response to the 2010 BP oil spill. The influx of ARRA funds in 2009 allowed funding of an increased number of standard and EAGER/RAPID grant awards. The ARRA funding impacted potentially transformative research projects that were identified by panelists, ad hoc reviewers or PDs, multidisciplinary projects, and projects proposed by beginning investigators.

**Recommendations:**

(1). MCB should continue its practices of innovation in the identification of emerging research areas. They are doing an excellent job.

**3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.**

**Comments:**

The MCB has done an exceptional job in program planning and prioritization of its research portfolio. The MCB Self Study indicated that the division utilizes different sources of information to prioritize its research investment. MCB PDs carefully consider numerous factors in the funding decisions and program planning. These factors included demographics, subject areas, annual reports, NRC studies, and "leading edge" discussions. This approach has helped maintain the funded research at the cutting edge of science despite its limited resources. In addition, MCB identifies hot topics by attending scientific meetings and communications with investigators. Scientific priorities identified by Congress also influence program-planning initiatives. MCB has sponsored workshops to highlight and develop ideas in emerging research areas.

The 2008 COV identified nine research areas that were thought to be important for keeping MCB at the leading edge of research. These research areas included: (1) Systems/network biology, (2) Metagenomics, (3) Synthetic biology at the molecular/cellular level, (4) Protein disorder and RNA structural plasticity in the control of biological functions, (5) Microbial mediated processes from cellular to community to global scales, (6) Epigenetics in eukaryotes, archaea, and bacteria, (7) Exploiting unusual or novel model systems, (8) Molecular processes in a crowded cellular environment, and (9) Continuing the emphasis on developing cutting-edge technology (e.g., subcellular imaging). The MCB reorganization has enabled these focused investments during the FY2008-10. The emerging areas of research that will be prioritized in future years (2011-13) were presented by the MCB DD.

- MCB and the BIO directorate should be commended for its seamless integration of pre-existing programs (for example, Arabidopsis 2010) into its current portfolio. It is presumed that this integration has been accompanied with an appropriate influx of research support dollars.

**Recommendations:**

- (1) MCB has a robust process for identifying cutting-edge research priorities.
- (2) It is critical for MCB to be attentive to its "core", while funding transformative research in the core areas and new emerging areas.

**4. Responsiveness of program to previous COV comments and recommendations.**

**Comments:**

Overall MCB has done an excellent job in responding to the comments and recommendations from the 2008 COV. The responsiveness of the Division/NSF to each of these issues is indicated in the table below.

The COV decided to use the following terms to convey MCB's response to the 2008 COV recommendations. If the comments and recommendations met expectations, the response was considered "adequate". If MCB's response exceeded the expectations, the response was considered "more than adequate". If MCB's response did not meet expectations, the response was considered "inadequate and needs improvement".

	2008 COV Evaluation	2011 COV Evaluation
<b>Proposal Review and Communication with PIs</b>		
1	Panel summaries need to be more consistent and informative.	<p><b>MCB's response was more than adequate.</b> These responses were clearly reported in the "Updates to the Response to Division Directors from the COV 2008". MCB has provided better guidance and improved oversight of panel summaries. Panel summaries explicitly address strengths and weaknesses in the intellectual merit and broader impacts sections in their reviews This is in part due to the fact that these sections are clearly called out in the Panel Summaries form. PDs and Division staff ensure that the panel summaries accurately reflect the discussions within panel.</p> <p>Assignment of the role of "scribe" is a new addition to the review process during the 2008-10. It has allowed for a more in depth evaluation of the grant and Panel discussions.</p> <p>MCB will have a summer intern evaluate the implemented changes and their impact to the quality of panel summaries.</p>
2	Ad hoc reviews need to be more consistent	<b>The response by NSF was adequate.</b> The COV Panel acknowledged that it is harder to get ad hoc reviews of the

	and informative.	same quality and balance of the two review criteria. Substantive comments for grant improvement within the ad hoc reviews need to be increased. Currently, the ad hoc reviewer form does not break out comments into strengths and weaknesses; this might enhance the quality of the ad hoc review.
3	Turnaround time -- Has the time to decision continued to improve?	<b>The response by MCB was more than adequate.</b> This has improved substantially. At the present time, 90% of the grants in MCB are processed within 6 months of receipt.  However, for PIs who did not receive funding, this time table makes resubmission for the next deadline nearly impossible. If there were mechanisms to provide reviews to PIs sooner, it would help PIs who need to resubmit.
4	Broader impacts need to be addressed more consistently in reviews	See comment in Part A4, Item 1 above.
5	Reporting of rationale for funding decision	<b>The response by MCB was adequate.</b> The PD rationale (Review Analysis) for the funding decision in eJacket is excellent. However, some of this detail and rationale does not always appear in the Panel Summary or in the PD comments. This is particularly an issue when there is a discrepancy in the panel rating and the final decision. More information needs to be supplied to the PIs on how a funding decision is reached.
6	Posting of substantive and deficient reviews for reviewer training. It was recommended that MCB create two fabricated reviews for the E and G/F categories.	<b>The response by MCB was adequate.</b> This issue was partially addressed. The NSF website provides the rationale for becoming a reviewer for the NS. While these fabricated reviews were provided to the COV in the Self Study, the committee recommends they are made accessible to all ad hoc reviewers and panelists via the website.
7	Personal instruction for new reviewers regarding panel mechanics and feedback on the first few reviews for a panel	<b>This issue was not addressed in the materials provided.</b> It should be noted that this was not discussed by the COV and questions to clarify this issue were not posed by the COV. MCB is encouraged to address this issue in the next review.

<b>Broader Impacts</b>		
1	Proposals should be required to document their training and outreach activities (COV 2005, COV 2008)	<b>The response by MCB was adequate.</b> The broader impact sections in proposals have variable content but appear to have improved due to better guidelines that are provided by the NSF.
2	Provide examples of broader impact activities on the website	<b>The response by MCB was more than adequate.</b> There is now an excellent document describing broader impacts. The documents provide a series of examples for PIs. <a href="http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf">http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf</a>
3	"Measurable outcomes of such 'broader impacts' must be carefully defined and evaluated during and after the funded grant period".	<b>The response by MCB was more than adequate.</b> MCB addressed this in several ways. Inspection of MCB awards for broader impact functions documented the % of awards with K-12 outreach and activities broadening participation of under-represented groups. A majority of the efforts to increase participation of underrepresented groups proposed only routine activities. Conclusions from this study are to be provided to panelists once the study is complete.  Division is proposing more specific instructions for broader impact activities in annual and final reports.  Based on successful activities identified in annual reports, PIs were invited to participate in a meeting to discuss innovation in biological research and education in MCB. The report was provided to the 2011 COV.
4	Contact information for NSF-funded educational programs should be provided to enable linkages with investigators	<b>The response by MCB was adequate, although some improvements can still be made.</b> MCB communicates its success stories via its "Highlights". Due to the COV 2008 recommendation, educational and broadening participation activities are now included.  The MCB also suggests for PIs to use the Research Coordination networks in Undergraduate Biology Education to enhance these initiatives. It is not clear how this information is conveyed to PIs.  However, at present it does not appear to be any web-accessible mechanism to identify scientists with innovative broadening participation programs.

		<p>MCB has provided brochures on “outreach” activities. These are often distributed at meetings. Web-based access to these brochures could not be found.</p>
<p><b>Tracking of trainees</b></p>		
1	<p>Track trainees from the grants (database development)</p>	<p><b>The NSF response was inadequate.</b> This has been requested by the 2002, 2005 and 2008 COV reports. No progress is apparent; it is overdue. Initially funding constrained development of the appropriate databanks.</p> <p>The 2008 COV report indicated that the NSF said it was developing a new reporting system to evaluate the impacts of training. However, it does not appear to have been deployed. The 2011 COV believes that tracking the undergraduates, graduate students and postdoctoral fellows supported by MCB, and all NSF, grants will provide the NSF with excellent data to document its efforts to grow the scientific workforce.</p>
2	<p>Ask PIs to provide/update the email addresses of current and former trainees</p>	<p><b>The response was inadequate.</b> MCB indicated that it cannot implement the 2008 COV recommendation due to the Paperwork Reduction Act that mandates that specific standards must be met prior to collecting information from the public by surveys, to prevent an undue burden. The burden to the trainees if requested to update career status and contact information might be minimal. The burden on PIs might be more substantial. The 2011 COV felt that this might be inconvenient for PIs but it is not an excessive burden on the PIs. PI responsibility for tracking their students and postdoctoral fellows should be considered part of the obligations of proposal funding. This tracking should be implemented as soon as possible. NIH is doing a similar process and there are advantage and benefits to tracking of former trainees.</p>
<p><b>Workload issues</b></p>		
1	<p>Workload issues are compromising the effectiveness of PDs</p>	<p><b>The response by MCB was adequate.</b> Permanent PD openings have been filled and this should provide institutional memory. The reorganization of the MCB has decreased proposal load for PDs and staff for each proposal evaluation period. However, PDs participate in numerous workgroups. Approximately 52 workgroups were listed in the MCB self-study. This is a significant time drain and these uncompensated mandates also put a burden on program directors.</p>

2	PDs had limited time for continuing education, public outreach, initiate new programs, and promote visibility (COV2008 indicated that the situation deteriorated since COV2005)	<p><b>The response by MCB was adequate.</b> During the fiscal years from 2008-2010, all administrative staff participated in professional development opportunities, which included training courses, travel to meetings, and details on other positions.</p> <p>With the increase of permanent PDs within the Division, it appears that PDs will now have more time to participate in professional meetings, conferences and workshops to identifying emerging areas of research and transformative ideas.</p>
3	All PD positions need to be filled to increase the number of permanent PDs (2005 COV, 2008 COV)	<p><b>The response by MCB was adequate.</b> Most permanent PD positions have been filled (Updates to the Response to the 2008 COV); one PD position is currently being searched for. Upon filling of this position, there will be a 1:1 ratio of permanent and rotating PDs.</p>
4	Training for PDs needs to be enhanced	<p><b>The response by MCB was adequate.</b> MCB PDs indicated that training activities have been improved but the exact changes implemented were not clear.</p>
5	Improve the eJacket work environment (2005 COV, 2008 COV)	<p><b>This was not specifically addressed in any of the MCB documents.</b> However, the COV found navigation within eJacket to be easy and progress of each grant and the decisions made are transparent. Conversations with the staff indicated that the eJacket environment is being improved (albeit slowly).</p>
6	Software modifications made but routine aspects of project management were not transferred to staff	<p><b>This was not specifically addressed in any of the MCB documents.</b> After conversations with staff, it does not appear that this remains an issue within MCB at the present time. There seems to be a good balance of workload between PDs and the MCB staff.</p>
7	Training on software modifications was needed for PDs and administrative staff	<p><b>This was not specifically addressed in any of the MCB documents.</b> After conversations with staff, it does not appear that this remains an issue within MCB at the present time.</p>
8	Re-evaluation of administrative tasks.	<p><b>The response by MCB was adequate.</b> There is a workload mitigation plan that is to be instituted in 2011. Program Directors and staff seem content and the problems that were apparent in the previous review appear to be resolved. .</p>
9	Need to reduce workload for PDs and	<p><b>The response by MCB was adequate.</b> There is a workload mitigation plan that is to be instituted in 2011.</p>

	Admin. Staff.	There is also an Administrative Task force. Program Directors and staff seem content and the problems that were apparent in the previous review appear to be resolved.
10	eJacket and electronic workload was excessive (COV 2005), problems continued and have been compounded by grants.gov. (COV 2008)	<b><i>This was not specifically addressed in any of the MCB documents.</i></b> A PD has complained about the job become clerical due to the eJacket. However, PDs and staff seem content and the problems that were apparent in the previous review appear to be resolved.

### Communications within the Division and BIO Directorate

1	Status of communications of DD and OAD (improved)	<b><i>The response by MCB was adequate.</i></b> Communications have improved. In 2010, town hall meetings held by the AD were begun. AD and OAD communicate with MCB via email, informal visits and meetings. BIO-wide social events enhance informal interactions.  An Administrative Functions Study was initiated that brings together Admin. Staff and office of AD.
2	Are PDs involved in decision-related conversations?	<b><i>The response by MCB was adequate.</i></b> AD now meets on a quarterly basis with Divisions in their regular staff meetings. Interviews with the PDs, DD and DDD indicated that members of MCB feel engaged in the decision making processes.

### Management structure

1	Assess management structure (clusters)	<b><i>The response by MCB was excellent.</i></b> NSF has realigned the three clusters (Biomolecular Systems, Cellular Systems and Genes and Genome Systems) in place at the time of the 2008 COV into four clusters: Biomolecular Dynamics, Structure and Function; Cellular Processes; Genetic Mechanisms; and Networks and Regulation.
2	Separate Panel to review high risk proposals	<b><i>The response by MCB was adequate.</i></b> MCB's response that high-risk panel is not recommended since panels tend to be risk adverse. The 2011 COV discussed this issue and has recommendations on this topic and mechanism of review for EAGER and RAPID grants. Please refer to section Part A1 Item 1a.

### Research Priorities

1	Encouraged to fund transformative research, but maintain the core of single-investigator proposals.	<p><b>The response by MCB was adequate.</b> MCB has revised its website to include this information. The MCB highlights (under “news” at website) and outreach presentations by PDs emphasized the importance of high-risk/high return research in its portfolio.</p> <p>MCB has increased the number of EAGERs to support transformative research.</p> <p>Idea labs were conducted on three topics (Synthetic Biology, Biological Imaging and Visualization, Photosynthesis). This has resulted in a dozen collaborative projects that were potentially transformative. While the Idea Labs impacted participants, it is not clear how these findings and directives are communicated to the scientific community at large. This should be evaluated by the next COV.</p>
2	Promotion of transformative research	<p><b>The response by MCB was more than adequate.</b> MCB piloted a study (the 2-page proposal and the Big Pitch panel) to determine if alternative methods for proposal evaluation would enhance the probability of funding of transformative research. In addition, the 2011 COV commend MCB for trying these experiments and pushing these frontiers.</p>
3	Change review form to include section for reviewers to identify transformative research. (high risk, high return aspects of the proposal)	<p><b>The response by MCB was adequate.</b> The criteria for evaluating the intellectual value of the proposal now include identification of transformative research aspects of a proposal. This strategy seeds the idea of importance of funding high-risk, high-return research. MCB Panelists successfully self identify transformative projects.</p> <p>MCB provided a clear rationale for not adding a direct question about transformative research to the review form. If this were added, it is likely that an exceptionally large numbers of grants could be identified as transformative by ad hoc reviewers and panelists. The COV agrees with MCB’s recommendations.</p>
4	Promote research in emerging research areas such as: systems/network biology, metagenomics, synthetic biology, protein disorder and	<p><b>The response by MCB was more than adequate.</b> Most of these research areas are already represented within MCB. MCB tracks these portfolio areas. MCB has expanded its past portfolio into these emerging area and the new realigned cluster emphasis these new emerging areas. MCB should be commended for its vision.</p>

	RNA plasticity in control of biological functions, microbial mediated processes, epigenetics, model systems (new or unusual), molecular processes in crowded environments, cutting-edge technologies ( e.g. imaging).	
5	Sponsor workshops to bring together individuals to foster interdisciplinary research.	<b>The response by MCB was adequate.</b> MCB has sponsored several workshops in new areas and emerging frontiers. For examples please refer to Part B Section 1. It is not clear how this opportunity to participate in such events is relayed to the scientific community.
6	Initiate a new postdoctoral program that promotes interdisciplinary research	<b>The response was adequate.</b> This is not an MCB specific issue. BIO established a working group to discuss new opportunities for postdoctoral fellows.

### Staff morale

1	Utilize staff talents. Staff need challenging and satisfying tasks.	<b>The response by MCB was adequate.</b> Routine tasks are not stimulating for staff. To expand staff skill sets and engage staff in more stimulating projects, more analytic projects were assigned (see Updates to the Response to the 2008 COV). The COV was concerned about increased workloads on staff. However, it appears that the MCB cluster reorganization may have alleviated some of the exceptionally high workload that was documented by the 2008 COV.
2	Career advancement opportunities.	<b>The response by MCB was adequate.</b> Some organizational and leadership opportunities are now available for staff.
3	Training Opportunities	<b>The response by MCB was adequate.</b> During the fiscal years from 2008-2010, all administrative staff participated in professional development opportunities, which included training courses, travel to meetings, and details on other positions. The staff was clearly enthusiastic and appreciative of these training opportunities.

4	Improvement of morale via social events (Staff and PDs)	<b>The response by MCB was more than adequate.</b> The steps taken at MCB and NSF have largely resolved the morale problems for staff and PDs. This is a major achievement. There are now BIO-wide social events and the AD participates. Within MCB, social events and retreats (2-d retreat and a Mall-strolling retreat) are used to enhance interactions amongst division members.
5	Recognition of Achievements	<b>The response by MCB was adequate.</b> Staff was recognized for their achievements and dedication to MCB. Certificates of achievement, special acts or incentive awards, and time-off awards. The staff was very appreciative of this acknowledgement of their efforts.

### The Research Portfolio

1	Remain diligent in funding transformative research and a diverse portfolio, while simultaneously monitoring the effects on single-investigator awards.	<b>This was adequately addressed.</b> See Section A3 for additional comments.
2	Encouragement to increase minority PI grant submissions and these efforts should be consistently implemented. Modest increase was seen in 2005-2007.	<b>This was adequately addressed.</b> Funding rates have improved significantly (see Section A3). During the meeting, COV learned that the RIG and CAA grants are being abolished, which is likely to have impacts on underrepresented groups and women. It is hoped that the NSF will implement another program to address these needs of the scientific community.
3	MCB should promote new and innovative science by the best researchers in the nation. This could mean "recruitment" of prominent researchers who are not currently NSF funded.	<b>This was adequately addressed and justification for not pursuing this recommendation was clear.</b> MCB indicated that inviting particular individuals to apply for MCB grants is inappropriate. It might send an unreasonable expectation of success to the PIs and create a perception of unfairness amongst the scientific community. In addition, transformative research is conducted by PIs at all stages of their careers.
4	Support for early stage investigators should be continued	<b>This was adequately addressed.</b> MCB provided data via their Information systems. It appears that ~60% of early-stage investigators who submit a subsequent

	and the success of young investigators should be made known to the scientific community	proposal to the NSF sustain funding beyond the first three years. The MCB Highlights provides examples of some of these success stories.
5	MCB should indicate that it welcomes innovation discovery based research.	<b><i>This was adequately addressed.</i></b> Web-based descriptions of MCB and the MCB Highlights demonstrate the willingness to support discovery-based research.  MCB indicated that discovery-based research proposals can have a disadvantage in Panels. Therefore they are often reviewed by more than one panel at the NSF.
6	MCB should have specific plans for transitioning successful "initiatives" into the Core programs.	<b><i>The response was more than adequate.</i></b> The MO/MIP and Arabidopsis 2010 program initiatives have been successfully integrated into one or more existing core programs. The programs that absorbed these initiatives received supplemental funding. MCB indicated that cluster descriptions were modified to include these research areas, investigators with expertise in these areas will be included on panels, and active outreach by PDs have enabled this transition.
7	Provide funding for an additional year at a 50% of the annual amount as a supplement to ensure early-stage PIs are successful in their renewals.	<b><i>This was not implemented and the justification for this decision was strong.</i></b> This is not allowed under current NSF policies. At the present time, NSF can provide up to six months of additional support to assure adequate completion of the original work proposed in the grant. They provide bridge funds in a small number of circumstances.
8	Make more early career award for three years	<b><i>This was adequately addressed.</i></b> Many grants to early career investigators are Career Awards. The current NSF policies dictate that the Career Awards are five years in length. MCB believes that it should not set the duration of an award. Investigators should be proposing the timeframe and resources needed to accomplish the goals of the grant, which might exceed a three-year period.

### COV Review

1	Chair of COV should be a recent COV participant	<b><i>This was adequately addressed.</i></b> The COV 2011 Co-chair was a member of the COV 2008. This memory from the previous COV review was deemed essential. For the next MCB COV, it might be useful to have 2-3 members of the committee with 2011 COV experience.
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2	Materials should be made available as far in advance as possible	<b><i>This was adequately addressed.</i></b> MCB did a fantastic job providing the COV with information as needed. MCB prepared a large number of thoughtful, informative and data rich documents to support the 2011 COV. A majority of these documents were available 1-2 weeks prior to the COV meeting. These documents included the previous COV report and responses, a large and informative Self-study, the charge to the committee and membership list. Some updates and additional materials were provided one day prior to the meeting. Having some of these "late" documents earlier might have better enabled the COV.
3	Training on eJacket should be provided	<b><i>This was more than adequately addressed.</i></b> Approximately, one week prior to the 2011 COV, MCB held a virtual meeting that introduced COV members to eJacket its resources and the wiki.
4	Per diem expenses should be provided for Committee members within close proximity to the NSF.	<b><i>This was adequately addressed.</i></b> This cannot be implemented. It is against NSF regulations on travel.
5	Provide the Chair names of COV member to promote early communications to prepare for the COV meeting	<b><i>This was more than adequately addressed.</i></b> The Committee membership was provided to all committee members months prior to the 2011 COV meeting. The Chair assigned members specific tasks for the review and encouraged members to draft responses prior to the meeting. This strategy great promoted the workload at the meeting.

## 6. Additional Comments

### Recommendations

(1) MCB should continue to assess the quality of the ad hoc and Panel reviews and their inclusion of substantive recommendations for proposal improvement. MCB should consider adding strengths and weaknesses sections to the ad hoc review template. This might enhance the quality of the ad hoc.

(2) MCB should determine a method for providing reviews to PIs sooner. It would help PIs who need to resubmit.

(3) Prior to the panel meeting, MCB PDs should provide instructions for new panelists regarding panel mechanics and feedback on the first few reviews to assure high-quality substantive reviews.

(4) The Proposal Review in eJacket has robust information about proposal review. Some of this information should be provided to the PIs on how a funding decision is reached. This is especially important when there is a discrepancy in the panel rating and the final decision

on funding for a proposal.

(5) MCB has created examples of substantive and deficient reviews that are useful for ad hoc reviewer and Panel member training. While these reviews were provided, the COV recommends that they are widely available via the website.

(6) The MCB should use the web to display resources to allow PIs to identify scientists with innovative broadening participation programs (eg., Research Coordination networks in Undergraduate Biology Education, Broadening Participation flyer, Broader Impacts flyer).

(7) The success NSF-trained scientists needs to be tracked. The tracking of undergraduates, graduate students and postdoctoral fellows supported by MCB will provide the NSF with excellent data to document its efforts to grow a high-quality scientific workforce.

(8) While advances in this area were substantial in 2008-11, MCB should continue to ensure that the 1:1 ratio of permanent and rotating PDs is maintained and all PDs have sufficient time for continuing education, public outreach, initiation of new programs, and promoting visibility.

(9) MCB should continue its new practices to keep the morale of PDs and staff at its current level of satisfaction.

(10) MCB should consult with rotating PDs and determine if the current efforts to train new PDs is sufficient or needs enhancement.

(11) MCB should continue to promote its transformative research initiatives.

(12) NSF should continue improvements to the electronic working environment that is used by PIs and staff. These innovations could reduce workload and enhance personnel productivity and satisfaction.

(13) The 2011 COV recommends that MCB should guide the next COV to draft sections of the COV document prior to attending the COV meeting. This was critical for informative discussions at the 2011 COV meeting.

(14) COV recommends the use of the interactive Wiki (or other similar program) for the assembly and discussion of the COV report. However, a mechanism to prevent technical "over-writing" of sections is needed to allow the wiki to function optimally.

(15) During the meeting, COV learned that the RIG and CAA grants are being abolished. The NSF should consider implementation of another program to address these needs of the scientific community.

# PART B.

## RESULTS OF NSF INVESTMENTS

The NSF mission is to:

- promote the progress of science;
- advance national health, prosperity, and welfare; and
- secure the national defense.

To fulfill this mission, NSF has identified four strategic outcome goals: Discovery, Learning, Research Infrastructure, and Stewardship. The COV should look carefully at and comment on (1) noteworthy achievements based on NSF awards; (2) ways in which funded projects have collectively affected progress toward NSF's mission and strategic outcome goals; and (3) expectations for future performance based on the current set of awards.

NSF investments produce results that appear over time. Consequently, the COV review may include consideration of significant impacts and advances that have developed since the previous COV review and are demonstrably linked to NSF investments, regardless of when the investments were made.

To assist the COV, NSF staff will provide award "highlights" as well as information about the program and its award portfolio as it relates to the three outcome goals of Discovery, Learning, and Research Infrastructure. The COV is not asked to review accomplishments under Stewardship, as that goal is represented by several annual performance goals and measures that are monitored by internal working groups that report to NSF senior management.

**B.** Please provide comments on the activity as it relates to NSF's Strategic Outcome Goals. Provide examples of outcomes ("highlights") as appropriate.

***B.1 OUTCOME GOAL for Discovery: "Foster research that will advance the frontier of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the nation as a global leader in fundamental and transformational science and engineering."***

**Comments.**

MCB has emphasized projects in the emerging and established areas of metagenomics, metabolic diversity in microbial communities, climate change, synthetic biology and energy. The focus on discovery-based research fields that straddle the interface between the disciplines of chemistry and biology, biology and mathematics, physics and biology, engineering/computer science and ecology has encouraged an influx of new investigators who have well positioned our nation as the global leader in these emerging areas. Noteworthy of MCB-supported projects have been multi-investigator projects under the auspices of the Arabidopsis 2010, Microbial Observatory (MO) and Microbial (MIP) programs, the National Nanotechnology Initiative (NNI) and two Physics Frontier Centers. Such thematic focus areas have significantly impacted the biological science knowledge base. In the period under review, significant results were reported in the

highest profile journals, *Cell* (13 publications), *Nature* (16) and *Science* (22). These publications encompass a range of topics such as completion/analysis of three plant genomes (i.e. *Brachypodium*, *Physcomitrella* and *Chlamydomonas*), functional metagenomics and microbial diversity, metabolic modeling, synthetic biology (i.e. expanding the genetic code), reconstituting bacterial RNA repair, metagenomics (siRNA mechanism) and enzymology (GTP hydrolysis, ammonia oxidation, purine biosynthesis).

Many of the truly transformative discoveries (some of which are outlined below) started out as research not presaged within grant proposals themselves. Indeed, these breakthroughs typically arose from research by individual investigators or by small tight-knit groups of collaborators who were well poised to recognize the significance of a novel observation owing to their disciplinary training, dedicated knowledge of the subject, and just plain luck. Some examples of breakthrough research at the frontiers of knowledge supported by MCB include:

**Highlight ID 19920:** Bonnie Bassler (Princeton) Identification of new small molecule inhibitors of quorum sensing in bacteria that is expected to lead to new approaches to treating microbial infection.

**Highlight ID 17405:** Jef Boeke (Johns Hopkins University) His lab's synthetic yeast chromosome design represents a proof-of-concept approach for customized synthetic eukaryotic species, which potentially will lead to development of eukaryotic organisms tailored for biotechnological/bioenergy purposes. This outstanding project is also notable because it heavily engages undergraduate students in research.

**Highlight ID 17512:** Jack Szostak (Mass General) Szostak's high-risk research seeks to recreate a self-replicating chemical-based proto-cell for testing a model for evolution of a biological (living) system from a purely chemical one.

**Highlight ID 15234:** Dr. Shana Goffredi (Cal Tech) MIP: Discovery of a specialized new bacterial symbiont-associated with a newly discovered polychaete worm genus that live entirely on whale carcasses in the harsh environment of high salinity, low temperature and low oxygen. This work not only informs new insights into a co-evolved biological 'system', but also holds great potential for identification of new enzyme catalysts with unique catalytic properties.

**Highlight ID 19917:** Hailing Jin (UC Riverside) Discovery of long siRNAs in plants that aids in resistance to infection by participating in the destruction of an inhibitor of the plant's defense system. The biotechnological applications of this MCB-supported work are self-evident.

An important subset of research area supported by MCB is relevant to understanding the causes and consequences of climate change. The Division has participated (and continues to participate) in major climate change related activities that cut across NSF Divisions and Directorates. These include the Ocean Acidification Program (10-530) and the Dimensions of Biodiversity Program (10-548, 11-518). In addition, the Division has participated in a BIO Directorate experiment in innovative research that focused on proposals relevant to climate change (see below). It is through this targeted activity as well as through the identification of relevant proposals within the core programs, that the Division has awarded 10% of its portfolio to projects that deal with the impacts of climate change on molecular and cellular processes. Examples of MCB projects relevant

to climate change are given in Appendix O2 prepared by MCB program staff.

Last but not least, MCB has well fostered research on curiosity-drive science of novel experimental organisms as well as on well-studied model plant (i.e. Arabidopsis) and animal (i.e. man) species that have lead to unexpected basic discoveries in biology. Examples of breakthrough research in these areas more fully depicted in MCB Highlights and Press Releases are outlined below.

**Highlight ID 15243:** Ray Gavin (Brooklyn College) The surprising discovery of endocytosis-mediated nuclear trafficking in *Tetrahymena* which fuels a new paradigm for lateral gene transfer and confirm the adage that “you are what your eat.”

**Highlight ID 17064:** Matthew Meselson (Wood Hole) Surprising discovery of large-scale gene transfer in Bdelloid rotifers, freshwater invertebrates first investigated by Leeuwenhoek, ‘the father of microbiology’ in the late 1600s.

**Highlight ID: 19914:** Jane Gitschier (University of California-San Francisco) Research in the Gitschier lab has provided evidence for the genetic basis of perfect pitch.

**MCB NSF.GOV.NEWS ID 111296:** John Logsdon (University of Iowa) and his colleagues reported the discovery of a new type of eukaryotic algal relative of the apicomplexan parasites, which cause malaria – a discovery that provides a bridge between two previously thought-to-be separate branches on the tree of life.

**MCB NSF.GOV.NEWS ID 111145:** Robert Blankenship (Washington University) Discovered a new red shifted chlorophyll in the reaction center of a newly described species of cyanobacterium, which extends the range of oxygenic photosynthesis to a spectral region not useful for most photosynthetic organisms. This work shows the adaptive plasticity of this organism to harvest light energy discarded by neighbors.

**MCB NSF.GOV.NEWS ID 114554:** Jean Greenberg (University of Chicago) Surprising discovery of azelaic acid’s role in plant innate immunity to bacterial infection that could lead to novel treatment of plant disease.

#### **New Innovative Methods for “seeding” transformative research:**

The COV particularly commends MCB for experimenting with new methods for generating and reviewing applications that propose potentially transformative research with broad impacts. Such experiments include The **Big Pitch** in 2010 and The **Ideas Lab** Concept in both 2009 and 2010 - the latter modeled on the “**sandpit**” process first developed by the Engineering and Physical Sciences Research Council (EPSRC) of the United Kingdom (UK). The “Big Pitch” experiment was designed to determine if review of short anonymous proposals focusing only on the main purpose and potential impacts of the research (in this case in the area of climate change research) would be more conducive to identifying potentially transformative research than the standard review mechanism. Interestingly, this experiment revealed a little overlap between proposals ranked for funding by the standard mechanism (control) compared with those of the experiment – a result indicating that more detailed information about the PI’s credentials and feasibility of the experiments factor significantly for the recommendation for awards.

The central feature of the **Ideas Lab** were intensive interactive residential workshops involving 20-30 participants, with the aim of developing new and bold approaches to

address grand challenge questions for topics that could benefit from a new dimension in thinking. Such workshops were held in the areas of Synthetic Biology (MCB and other directorates at NSF), Biological Imaging and Visualization (DBI, MCB, DEB, EF) and Photosynthesis (MCB, IOS, EF). These interdivisional programs nearly doubled the success rate for funding from individuals who participated. Other examples of relevant synthetic biology proposals funded in MCB are outlined in Appendix O8.

### **Recommendations.**

MCB is commended for the outcome of their investments and is encouraged to continue to emphasize 'discovery-based research' and collaborative interdisciplinary projects with more accountability for progress toward the broader impact objectives being better assessed. The ideal portfolio will have a mixture of hypothesis driven and discovery based research. The focus on model systems has been extremely important for understanding a small subset of living organisms in depth, and continues to nurture and inform a larger community of biologists. Support for these projects should continue within the mainstream proposal system, while a more targeted approach to address biological processes of importance to national priorities is pursued in parallel with rigorous peer review. While such targeted funding is good for advancing the fields so identified, this funding mechanism necessarily occurs at the expense of funding for other fields and thus the transformative nature of such awards need to be critically evaluated by the next COV.

## **B.2 OUTCOME GOAL for Learning: “*Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens.*”**

### **Comments:**

The NSF impacts the scientific workforce by providing significant support of research training for undergraduate and graduate students, post doctoral researchers, K-12 educators and K-12 students. MCB support of these activities is consistent with the overall emphasis to combine research and education. Training is supported directly through regular award mechanisms and as well as through other programs including REU, RUI and targeted STEM awards. The participation of K-12 educators in professional development and K-12 students in authentic research activities is critical to the development of the next generation of scientists. Expanding the public's understanding and appreciation of the work that scientists do are important components to assuring a scientifically literate citizenry. Approximately 53% (62/117) of the files presented in document H (Appendix to the Self Study) indicated some involvement in training and/or community outreach. Some of these included excellent outreach programs to K-12 students. Others indicated efforts to improve the participation of women or other under-represented groups in science. A recent MCB intern undertook an analysis of MCB's support for training. We commend MCB for investing in this activity. The changing demographics of the US require that science attract the next generation of scientist from populations that have traditionally not participated in scientific endeavors.

**Notable Training and Educational Awards in:**

**08177787** The Role of Nuclear Periphery in Chromosome 3D---a teaching tool for 2<sup>nd</sup> graders

**0642843 Career:** Genomic-wide Analysis of Pathogen Induced Endogenous siRNAs in Plant Defenses in Arabidopsis

**0419909** Molecular Mechanisms Controlling Heritable Epigenetic Variation

**0843073** Transcript Regulation During Oxidative Stress

**080783** sLowlife Community- outreach.

**Highlights from K-12 outreach provided in self-study Appendix O10**

**Proposal # 0843611:** *Origins and Evolution of tRNA Synthetase Fidelity Modules*

Dr. Susan Martinis goes into a 1st grade classroom to read and discuss the book *The Invisible ABC's*, then they set-up an experiment on "Catching microbes". Students watch for and then draw the bacteria that grow in the Petri dishes along with some other art projects to help them understand about traits of bacteria. Dr. Martinis repeats this same project in pre-schools. She has found that these outreach activities have a positive impact on the students and teachers she works within the classes.

**Proposal # 0844715** *Cyclic nucleotide gated Ca channels and non-self perception in plant pathogen defense responses*

Dr. Gerry Berkowitz developed and ran an innovative molecular biology teacher-training practicum. Participants this past summer included students in agriculture education and School of Education programs who will be future K-12 educators, as well as current high school teachers. The goal of the two-week full day practicum is to provide future K-12 teachers with intensive training, resources, and support so they can deliver a series of lab modules to high school (agriculture or biology) students that fulfills the genetics requirement of a biology course. Many hundreds of high school students have been educated about molecular biology using these lab modules by K-12 teachers with whom PI Berkowitz has already worked. These students undertake this learning as part of a project where they 'assist' a research professor at a university with research about an ion channel protein.

**Highlight ID: 19997, Version: AC/GPA**

Laurie Stargell and her team at Colorado State University have been addressing the fundamental biological question about how genes are turned on and off during growth and development. Using yeast as a model system, their most recent work indicates that coactivators play essential roles in activation of gene expression in response to specific environmental changes. Coactivators are composed of dozens of protein subunits, which are conserved from yeast to humans. Thus, continued studies in yeast will enhance our understanding of the universal features of gene expression.

**Recommendations:**

Clearly there has been effort by MCB to promote the education and student training mission of the NSF. However, there is no way to know whether the proposed activities were actually accomplished and what the outcomes of the training, outreach and education activities were. How many people are actually affected by each award? Tracking participants would help determine the effectiveness of this critically important

part of NSF's mission. Better accountability of broader impact activities and evaluation of them would further highlight MCB's success in this area.

**B.3 OUTCOME GOAL for Research Infrastructure: "Build the nation's research capability through critical investments in advanced instrumentation, facilities, cyberinfrastructure and experimental tools."**

**Comments:**

MCB supports research projects primarily and much less so infrastructure. MCB's goal is not that of sustaining infrastructure for molecular and cellular biosciences although, some projects may result in producing large data sets. MCB provides targeted support for the development of research infrastructure at institutions, and new experimental systems, databases and technologies for the biological community. In the Directorate for Biological Sciences, all major infrastructure activities are managed through a separate Division- the Division of Biological Infrastructure (DBI). Many infrastructure projects that are critical for developments in the molecular and cellular biosciences are funded through DBI. Examples include the Protein Data Bank, The Arabidopsis Information Resource, and many stock centers.

Some specialized databases and resources in the MCB portfolio include (provided in the self study include Appendix "O-10"):

**MCB - 0929402 Ecker, Joe**

**Arabidopsis 2010: 1,001 Genomes Project**

Although the original project was aimed at determining genome sequences and developing SNP database for 1001 accession numbers, the project was funded at a reduced level for 200 accession numbers. So far the pipeline for data has begun and a database has been developed. Further refinements in the database and deposition of additional data are progressing rapidly.

**MCB - 0618433 Carrington**

**Arabidopsis 2010: Functions of Arabidopsis Small RNAs**

This project has developed a widely used database of Arabidopsis small RNA sequences and functions (<http://asrp.cgrb.oregonstate.edu/db/>). The database currently contains 441596 reads of small RNA sequences.

**MCB - 0618402 Frommer, Wolf**

Arabidopsis 2010: Towards a Comprehensive Arabidopsis Protein Interactome Map: Systems Biology of the Membrane Proteins and Signalosome

In this project, Frommer and his colleagues have developed new gateway vectors for expression of membrane proteins; the complete original mbSUS system with all vectors and strains is available at ABRC (cf. *Reagents* at [www.associomics.org](http://www.associomics.org)). A total of 2106 ORFs in Gateway vectors without stop codon have been submitted to ABRC. By the end of this project term, another 1000 clones will be submitted. This research has led to development of protein interaction maps for membrane proteins and signalosome proteins. They have also developed the framework to build a high-confidence protein-protein interaction network from wet-lab experiments. Statistical and machine learning methods are applied to significantly remove false positives. The researchers have

released two searchable databases for 3.4 million membrane/signaling protein interactions (MIND 0.5Membrane-protein Interaction Network Database).

**MCB also supports research projects that may result in new**

**methods.** Development of new methods is a priority for MCB. Many projects funded by MCB are designed specifically to develop new methods. The following were provided in Appendix "O-10" of the Self-study.

**MCB - 0968976 Selvin, Paul**

EAGER: Single Quantum Dots via 2-Photon Excitation

The PI (Selvin) was awarded a \$50k grant to spend seven weeks at MBL during Summer 2010, where he built a special microscope (funded by Nikon) optimized for single-molecule microscopy. Several super-resolution techniques exist, yet they require multiple lasers and/or specialized fluorophores. Hence, super-resolution is out of reach of many laboratories. The PI showed a simple form of super-resolution microscopy that exceeded the standard diffraction limit by 5-15x. It uses bright, organic fluorophores and a sensitive camera, both of which are commercially available.

**MCB - 0940914 Woodbury Neal**

EAGER: The Topology of Peptide/Protein Interaction Space

We have been transferring a technology, developed by Intel, for the production of peptide arrays to a laboratory at ASU and then demonstrating that this technology can be used in the exploration of the functional topology of peptide space. They have now optimized the technology and transitioned it into a start-up company. There are many applications of peptide chips medicine and environmental biology. The new company, HealthTell, LLC has been formed and the fabrication process for the peptide array chips has been transferred to this company. It has secured access to a fabrication facility in Belmont California and will soon start producing these chips, making them available broadly to the scientific community.

**MCB - 1052623 Winter et al.**

Collaborative Research: QSTORM: Switchable Quantum Dots and Adaptive Optics for Super-Resolution Imaging

This project proposes a new super-resolution imaging technology: QSTORM, which combines user-controlled, switchable quantum dots (QDs) with specialized computer-based algorithms (STORM) and adaptive optics to enhance images. QSTORM will, for the first time, enable imaging in living cells with a resolution superior or comparable to other super-resolution techniques.

**Recommendations:**

MCB's support of some research projects result in new methods, research databases and other research resources. This is a welcome outcome.

# PART C.

## OTHER TOPICS

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

**MCB's Role in the Scientific Landscape:** MCB funds an impressive and broad array of topics in molecular and cellular biology. In considering the role that the NSF plays in the overall funding landscape, one needs to also consider how the NSF programs complement the activities of other agencies that fund biological research, such as NIH, HHMI, ACS, DOE, and others. The scientific areas in MCB overlap, to some extent, the portfolios for other funding entities. The NSF portfolio also includes an emphasis in other areas, such as plant biology, NSF-wide topics in Biocomplexity in the Environment, Information Technology, Nanotechnology, and the integration of research and education. To support this broad array of programs with a budget of about **\$130 Million per year** is a challenge. The particular niche that MCB occupies in this environment should be given careful consideration.

***Distribution of Scientific Topics across MCB:*** It is clear that MCB supports a broad array of scientific topics through its three previous (now four) clusters. There are no obvious gaps or scientific areas that have been overlooked. In some cases, however, there appear to be a disproportionate number of awards made in one area versus another. For example, in the Cellular Systems Cluster FY 2008 Annual Report, Table 2, where there are 18 separate categories identified, 48% of the awards were made in signaling and regulation, 31% in spatial organization, and 34% in morphogenesis and development. Other important areas, such as synthetic biology or extracellular matrix, received only 3% and 5% of the awards, respectively, during FY 2008. In contrast, in the Biomolecular Systems Cluster, the number of awards made across the 11 categories remained fairly consistent from FY 2005-FY 2008 (FY 2008 Annual Report, page 8). The yearly distribution across cluster categories for FY 2008 – FY 2010 is difficult to assess from the Analysis of Cluster portfolios data provided because the numbers of awards are not consistently broken out for each fiscal year.

***Maintaining Program Balance v. Strategic Investments in Focus Areas:*** The distribution of funds across topic areas, as well as its variation, raises questions about how decisions are made to maintain program balance. Is there a process for ensuring that balance is maintained? What are the checks and balances to guard against the particular biases and interests of any given program director in the decision-making process? Are there consistent efforts made at the Division level to review the distribution of funds and to make corrections to keep the breadth of scientific areas healthy? It would help the COV to see a summary or analysis of the distribution of existing/ongoing grants in the scientific areas across the Division to determine if the entire cohort of grants reflects the same distribution of topics as the newly awarded projects.

**Breadth vs. Depth:** The wide breadth of scientific topics within the three existing clusters in MCB during 2008-10 is an impressive challenge, considering the total number of awards that can be made with the available funds. In any given year, the number of non-ARRA awards made by each of the three clusters ranges from 50 to 80. Each of the clusters covers 7-20 different topics. Funding for any particular area is therefore limited. Some important topics in biology are represented by a very small number (< 3) of awards per year. Is this wide distribution of science the result of decision-making by program directors or simply the result of application pressure? Are there some areas that are of more significance for the NSF? Should consideration be given to the idea of concentrating the funds in specific areas of high impact or areas that can be considered "signature" projects? MCB should think about their specific niche, where their greatest impact will be with respect to other agencies such as the new emerging area of synthetic biology. The Arabidopsis 2010 program is also a good example of a program that has had a big impact on the community.

## **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**

**Objectives and Goals:** Objectives and goals for MCB are set at a number of different levels. On a more global scale, there are those set by the NSF Strategic Plan (Discovery, Learning, Research infrastructure and Stewardship), or by the Office of Management and Budget (Understanding Complex Biological Systems, Advanced Networking and High-End Computing, National Nanotechnology Initiative). In addition, there are the emerging areas identified by the previous Committee of Visitors in 2008 (page 23 of the COV 2008 report) that include systems biology, metagenomics, synthetic biology, protein disorder, epigenetics, phenomics etc. On a more local level, there are the review criteria (intellectual merit and broader impacts) that are used to directly rate each proposal. Since it is difficult to assess which overall goals the COV is to address, comments here will be limited to several points raised in the Self Study Report where data are specifically provided. The assumption here is that 'near' goals are set for funding, the success is tracked, and the outcome is reported to the COV. While there are many goals that could be pursued, the NSF and MCB can add the most value are in areas that are not priorities for other agencies.

**High-risk projects:** Program directors in MCB make a concerted effort to identify and fund high-risk research through specialized programs (Small Grants for Exploratory Research, SGER, and Early Concept Grants for Exploratory Research, EAGER). Although the numbers for high risk projects seem surprisingly low (Table 22 of Self Report) for FY 2008 – FY 2010, efforts were also made to fund high-risk research through the regular funding channels. In addition, there was a pronounced increase in the number of awards in this category in FY 2009 due to ARRA funds. We support their efforts to fund high risk research and MCB should continue to find the best mechanisms to support high risk research.

**Integration of Research and Education:** The success of specific programs designed to integrate research and education, such as the CAREER and RUI awards is outlined in Table 21 of the Self Study Report. It is clear that the success rate for these is high. For

RUI awards, for example, the success rate was ~40% for FY2008 and FY2009, and even higher for FY2010. In addition to the awards, PIs can obtain supplements to their research grants. The success rate for RET supplements (K-12 teachers), REU supplements (undergraduate students), and ROA supplements (for faculty to take leave from teaching institutions) is extremely high, near 100%. It would be interesting to know how these high success rates translate into higher promoting scientific careers in these groups or if any tracking is done to show the success of these programs/individuals after receipt of these awards.

**Portfolio Demographics:** In the Analysis of Cluster portfolios, statistics are given for the success rates for women, minorities, new PIs, renewals, EPSCoR, CAREER and RUI, RIG-CAA proposals for each cluster. The Biomolecular Systems and Genes and Genome Systems Clusters were consistent in their funding across these categories for FY08 and FY09, with most success rates ranging from 11% to 49%, with most falling above 20%. The success rates in these categories for the Cellular Systems Cluster were generally lower. All three clusters showed increased success rates in FY09 because of ARRA funding. Because there are no Division target numbers or quotas in these areas, it is not apparent what guidelines are used to promote funding in these areas or how the decisions are made. An important aspect of the data provided to the COV is the lack of information on the longer-range outcomes of individuals receiving these funds. Do these awards or programs make a difference? What are the efforts to track outcomes to better understand if the high success rates in these outreach/diversity programs are accomplishing their intended goals?

**Collaborative and multidisciplinary research:** MCB should be commended for their efforts to support multidisciplinary research, as shown in Tables 23 and 24 of the Self Study. In addition, the new permanent PD will have desired computational biology experience. In spite of these positive efforts, the data presented in Tables 23 and 24 may not accurately capture the true statistics for multidisciplinary research. These numbers are based on self-reporting by the PIs. It is very possible that this exercise encourages PIs to check boxes on the application that represent adjacent areas of science or interests of the PI rather than reflect true multi-interdisciplinary projects. Before presenting these data (55-59% of the MCB research portfolio is multi-disciplinary research) as fact, it would be important to validate the multidisciplinary nature of these projects through other types of measures.

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

**Ad hoc Reviewers:** One problem that the COV identified is a low ad hoc reviewer acceptance of invitations to review grant proposals During FY2008-2010 only 39%-40% of requested reviews were returned to the MCB Division (Table 20 of the self-study report, page 31). Moreover, some reviews were incomplete, which decreases the actual number of reviews that were used in the process. To some extent this issue is common to all NSF programs. In FY 2009 65% response rate was average across all NSF Divisions (Report to the National Science Board on NSF's Merit Review Process FY 2009, page 33).

The COV also noted that ad hoc reviewers are sent full proposals prior to agreeing to confidentiality. One suggestion is to only send the summary page and title to ad hocs. A second suggestion was to perhaps include in on the web page a confidentiality agreement clause.

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

**Reviews and Broader Impacts:** The NSF criteria for review of proposals on the basis of Intellectual Merit and Broader Impacts are a hallmark of NSF proposal and are outlined in the Grant Proposal Guides. However, the subjectiveness for assessing Broader Impacts may be one reason why reviews may lack "substantive" information on this requirement (Table 9, Self Study). The COV recommends that reviewers be given directions for analyzing broader impacts and how to capture that information in their reviews. Also, broader impacts could include work that involves training of public school teachers.

**Underrepresented Groups:** While the Self Study summarized that the percent of women reviewers stayed steady at about 30% (Table 14) as did the percent of minority reviewers (at ~10%, Table 15), the report did not make reference to the gender and ethnicity of applicants. It would be important to NSF and the greater scientific community to know if the percentage of women and minority reviewers mirrors the percentage of applicants from these two groups.

**PUI:** Although the numbers given in the Self Study Report do not represent the total number of proposals submitted and those awarded, from the numbers given in Table 21, the result is both a good, yet puzzling, picture. The good news is that NSF made >25 awards at PUIs, however, the number of proposals from these schools tremendously decreased (from 70 in 2008 to 45 in 2010--a 35 % decrease). The COV recommends that MCB inquire with these institutions to arrive at a reason for this decrease. It is possible that this decrease is due to ARRA funding a large # of projects in 09--hence few in 2010. The answer needs to be investigated by NSF. We note that PUI institutions are at the heart of training the next generation of undergraduate scientists, and support of the work at these institutions should be continued.

**RUI:** One troubling observation is the 36% decrease in the number of RUI proposals between 2008 and 2010 (Table 21, Self Study). If this is a trend (a downward one), the COV would suggest that NSF do a focused group analysis like the one done by the ASBMB with regard to URMs, to assess this problem.

**Tracking Trainees:** The COV recommends that NSF develop ways of tracking NSF funded undergraduates and graduate students trained on NSF grants.

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

**COV Panel Memory:** The COV suggests including more (up to 50%) members from the previous committee to serve on future COVs. This will ensure continuity and insure institutional memory. The “veteran” members will share their experience with new members that will promote the efficiency of the review process.

**Timing of COV Documentation:** The COV recommendations for the improvement of the COV review process are similar to those that had been highlighted in the FY 2008 report. The COV suggests providing documents far in advance to guarantee sufficient time for thorough study of documents and for communication between COV members to ensure high-quality reviews. The critical documents and access to the e-jackets should be granted at least five-six weeks in advance. The specific assignments should be sent out at the same time to allow enough time for study, discussion, and writing of evaluations.

**Online Instruction:** The WebEx meeting should be held at least a month ahead to guide committee members through the process and repeated later if needed.

**COV Wiki:** The COV recommends that the Wiki page be a permanent part of the review process. It helped expedite the work, and allowed for useful feedback and discussion. However, a mechanism to prevent technical “overwriting” of sections should be implemented.

## **C.6 Division-specific questions:**

**MCB would like your advice about several questions related specifically to the Division:**

**1. What new opportunities in molecular and cellular biosciences should the Division address?** In addition to the emerging areas identified by the previous Committee of Visitors in 2008 which include systems biology, metagenomics, synthetic biology, protein disorder, epigenetics, the COV identified potential new areas of research/education for MCB consideration:

### **Within Biology**

Phenomics: Genomes-to-Phenomes

Real-time Biology: Dynamic responses of molecules, cells, populations and systems

### **Interdisciplinary**

Computational and Predictive Biology

Bio-inspired design of materials, processes, and machines

### **Response to Societal Needs**

Biology for Sustainability (e.g. Clean energy, oil spills)

### **Infrastructure**

High throughput phenotyping facilities

Real-time super high resolution imaging

Cyber enabled use of instrumentation

## **Broader Impacts/Education**

Priming the stalled pipeline: A path from PhD to professor

Enlist professional assessment of broader impacts (e.g. quantitative metrics).

### **2. How can the Division encourage interdisciplinary and integrative research in the cellular and molecular biosciences?**

#### **Comments:**

MCB should continue to promote inter-disciplinary research and training among biology and the other disciplines including chemistry, math, computer science, physics, and engineering. More inter-directorate panels and program directors with associated budgets to create think tanks and working environments that inspire new innovative fertile ground should be implemented.

### **3. How can the Division assess the quality and impacts of science supported by the Division?**

#### **Comments:**

The metrics that indicate that a new research area seeded by NSF funding is having a significant impact in science can be measured by a number of metrics including: 1) workshops and conference sessions at national and international meetings; 2) new investigators drawn to the field; 3) the number of grant applications in this research area; 4) the number of publications, citations and review articles; and 5) patents and industries' activity related to the field.

### **4. How do we, as an organization that supports fundamental molecular and cellular research, promote issue-inspired science, such as research that addresses societal needs?**

#### **Comments:**

Because MCB's mission encompasses organismal responses to changes in their natural environment, its research portfolio should be especially attuned to and responsive to global and societal issues related to these changes. In addition to the RAPID mechanism, we are suggesting that supplements to existing research that specifically address the issue could also be funded.