

NIH Scientific Management Review Board

Working Group on Pre-college Engagement in Biomedical Science

FINDINGS & RECOMMENDATIONS

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ROSTER

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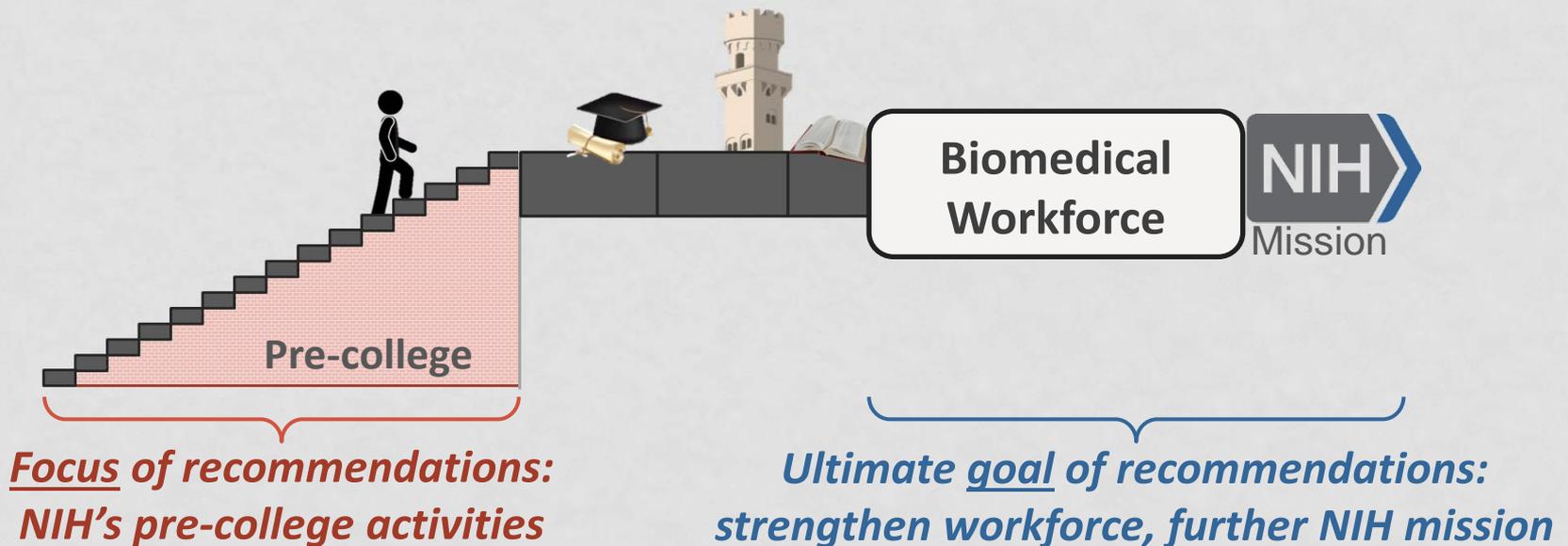
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CHARGE

To recommend ways to optimize NIH's pre-college programs and initiatives that both align with the NIH mission and ensure a continued pipeline of biomedical science students and professionals



ELEMENTS OF THE CHARGE

In addressing this charge, the SMRB should:

1. Examine the **evidence base** for successful approaches for pre-college biomedical science programs aimed at strengthening the biomedical workforce pipeline;
2. Identify the attributes, activities, and components of **effective pre-college biomedical science programs**, including the role and relative importance of teacher training programs;
3. Identify those points in the pre-college **biomedical workforce pipeline** where NIH's efforts could be applied most effectively, given finite resources; and
4. Define ways for NIH to **improve the evidence base** for effective pre-college biomedical science programs.

GENERAL FINDINGS

- **Alarming trends suggest that the current and rising scientific workforce may not be fully prepared to address the increasingly complex nature of biomedical research, nor reflect the diversity of students seeking careers in relevant fields**
- **Education disparities harm millions of students, especially minority and poor students**
 - Uneven distribution of well-trained science teachers and resources
 - Lower academic and career expectations for under-represented minority students
- **These issues will need to be addressed nationally by political and community leaders, policy makers, and other decision makers**

GUIDING PRINCIPLE

- NIH's pre-college STEM activities need a rejuvenated integrated focus on **biomedical workforce preparedness** with special considerations for **under-represented minorities**.

OVERARCHING RECOMMENDATION

- **Establish a transformative body with strong galvanizing leadership and with representation of all relevant NIH ICs and Offices and committed non-NIH stakeholders to oversee the:**
 - Development of a uniform reporting template of NIH sponsored pre-college STEM programs;
 - Creation and maintenance of an inventory of all programs;
 - Development of optimum processes for the functionality of all current and planned programs;
 - Coordination of these programs, including synergy with other Federally supported pre-college STEM activities; and
 - Development of evaluative criteria to gauge the success of these programs.

STEPS FOR NIH

- **Step A.** Focus pre-college efforts on the most pressing workforce needs
- **Step B.** Coordinate and cultivate effective programs and approaches
- **Step C.** Leverage strengths of the public and private sectors

FINDINGS RELATED TO NIH'S STEM PROGRAMS

- 1. There are limited opportunities for under-represented minority and low SES students to engage in biomedical science education.**
2. A broadening of workforce categories is important to convey to pre-college youth who might consider careers in biomedicine.
3. NIH has a large portfolio of pre-college STEM activities and should seek to streamline and enhance effectiveness through increased coordination.
4. There are no standard measures of success for the existing NIH pre-college STEM activities. A more rigorous evaluation process may strengthen all activities and produce new best practices.
5. There is untapped potential of NIH's research community.
6. There are many opportunities to partner with other entities committed to pre-college STEM outreach.

FINDING 1: Limited opportunities for under-represented minority and low SES students

- Overall makeup of the workforce is decidedly lacking in diversity, especially in positions of leadership.
- STEM attitudes are positive at a young age across gender and racial/ethnic groups, but access and performance gaps begin to appear in elementary school.
- Strong need to engage and retain under-represented and low socioeconomic status (SES) students and improve their access to educational and career opportunities.

FINDING 1: Limited opportunities for under-represented minority and low SES students *(Cont.)*

RECOMMENDATIONS

- Better target NIH-funded education outreach to students from under-represented groups and their teachers.
- Promulgate best practices of exemplar programs with a track record of directing under-represented minorities students toward careers in biomedical science.
- Utilize demonstrably successful NIH enrichment programs (e.g., summer internship programs) as opportunities to enhance diversity.
- Closely monitor the outcomes of NIH's nascent undergraduate under-represented minority recruitment, mentoring, and training programs [NRMN and BUILD] to determine whether these strategies could also be employed with middle and high school students and their teachers.

FINDINGS

1. There are limited opportunities for under-represented minority and low SES students to engage in biomedical science education.
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FINDING 2: Broadening of workforce categories is important to convey to youth

- There is no consensus on the optimal size of the biomedical workforce.
- New job categories constantly emerging.
- There is a need to cultivate cross-disciplinary science and opportunities for young people to bring new capabilities.
- Without a broader conceptualization of cross-disciplinary scientific needs and a more encompassing definition of careers in biomedical science, it is difficult to assess quality of the workforce and to define future needs.

FINDING 2: Broadening of workforce categories is important to convey to youth

Biomedical Workforce

Principal investigator

Clinician scientist

Postdoctoral researcher

vs.

Biomedical Workforce

Tech transfer officer

Science teacher

Clinical trial coordinator

Veterinarian

Journal editor

Pharmaceutical manufacturer

Clinical nurse

Staff scientist

Statistician

Clinician

Principal investigator

Clinician scientist

Postdoctoral researcher

Science policy analyst

Computational biologist

Grant manager

Regulatory official

FINDING 2: Broadening of workforce categories is important

RECOMMENDATIONS

- Emphasize the wide range of current and future career options available to students.
- Promote the cross-disciplinary nature of innovative biomedical science.
- NIH's STEM education programs should be informed by the work of the NIH Division of Biomedical Research Workforce Programs in order to:
 - understand the composition of the current biomedical workforce
 - project future workforce needs, and
 - identify emerging skills that should be fostered in K-12 education settings.

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FINDING 3: Streamline and enhance effectiveness through increased coordination

- NIH supports a number of STEM programs targeted at pre-college students and teachers, (e.g., SEPA, summer research programs), but these efforts are largely ad-hoc and uncoordinated.
- The suite of current NIH programs lacks both a central reporting structure and an ongoing infrastructure to ensure accountability.

FINDING 3: Streamline and enhance effectiveness through increased coordination *(Cont.)*

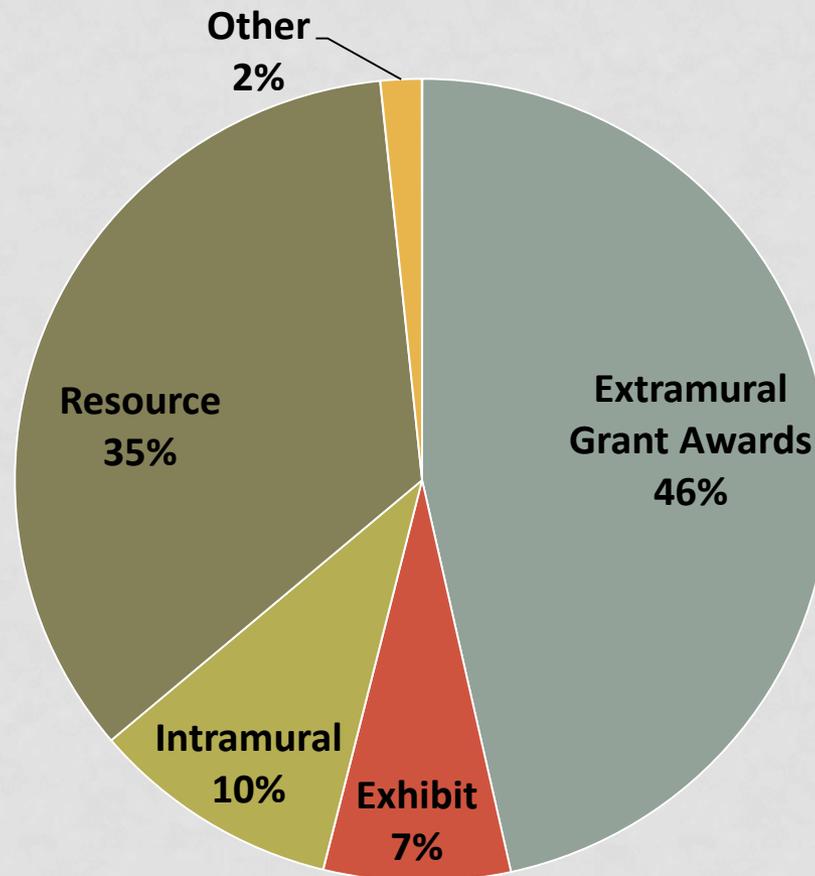
INVENTORY OF NIH'S PRE-COLLEGE ACTIVITIES

- NIH staff reported a total of 246 pre-college STEM activities
 - 117 grant awards
 - 35 internship programs
 - 19 curriculum supplements
 - 66 teacher development activities

Note: Criteria for identifying pre-college activities may have varied by IC and office.

FINDING 3: Streamline and enhance effectiveness through increased coordination *(Cont.)*

INVENTORY: Types of activities



FINDING 3: Streamline and enhance effectiveness through increased coordination *(Cont.)*

RECOMMENDATIONS

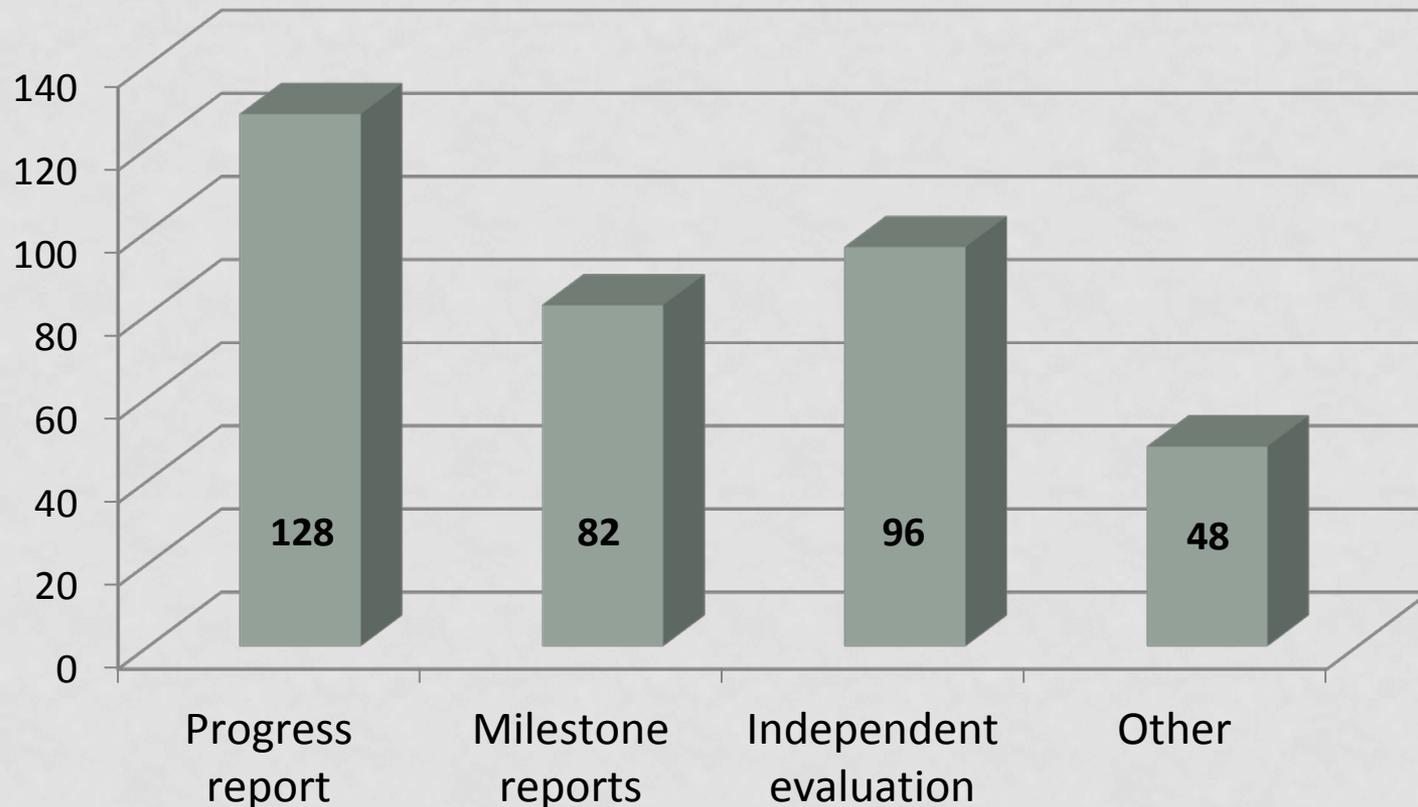
- As set forth in the WG's overarching recommendation, NIH should establish a transformative body to develop plans for coordinating, monitoring, and systematically evaluating NIH's pre-college activities.
- This body should emphasize efforts to:
 - Strongly encourage all NIH-supported STEM programs to increase outreach to under-represented populations.
 - Identify best practices and expand exemplar programs.
 - Identify resources to be provided to those engaged in teaching or mentoring pre-college students.
 - Provide an infrastructure and process to enable curriculum developers to identify and collaborate with subject matter experts at NIH.

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FINDING 4: More rigorous evaluation process may strengthen all activities

INVENTORY: Evaluative Methods*



*More than one of these methods may be applied in a single project.

FINDING 4: More rigorous evaluation process may strengthen all activities *(Cont.)*

- Variety of evaluative methods in the inventory speaks to a key challenge of the STEM education enterprise: the lack of strong, evidence-based criteria by which to gauge effectiveness.
- There is little empirical evidence on specific programs or educational approaches that are effective, either for improving science teaching or student learning outcomes.
- Without an evidence base for what works, it is impossible to precisely define the attributes of effective STEM programs; however, there are opportunities for NIH to improve evaluation of its pre-college activities.

FINDING 4: More rigorous evaluation process may strengthen all activities *(Cont.)*

RECOMMENDATIONS

- Identify and track the development of STEM education best practices and evaluation standards.
- Define successful outcomes (to include careers listed under the broader definition of the biomedical workforce).
- Develop metrics needed to evaluate the effectiveness of extant NIH STEM programs.

FINDING 4: More rigorous evaluation process may strengthen all activities *(Cont.)*

RECOMMENDATIONS *(Cont.)*

- Apply systematic and comparable evaluation practices for NIH's pre-college programs.
- As the evidence base for pre-college STEM education grows, determine the feasibility of expanding evaluation metrics to include measures of long-term program effectiveness.
- Work with other agencies and organizations to improve the collection of longitudinal, student-level data, especially as they relate to pre-college student's exposure to biomedical and human health learning experiences and eventual career trajectories.

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FINDING 5: Untapped potential in NIH's research community

- Leveraging NIH's existing network of funded research centers offers an effective and cost-efficient opportunity to increase NIH's impact on pre-college engagement in biomedical science.
- NIH supports more than 300,000 research personnel at over 2,500 universities and research institutions as well as 6,000 scientists and clinicians in the intramural program.

FINDING 5: Untapped potential in NIH's research community *(Cont.)*

- Many NIH-funded universities, investigators, and trainees already devote time and resources to teaching, tutoring, mentoring, and providing hands-on research experiences to pre-college students and teachers.
- NIH should continually identify effective, scalable programs at U.S. universities that can be highlighted and emulated around the country.
- The biomedical research community needs to make pre-college student outreach part of its culture.

FINDING 5: Untapped potential in NIH's research community *(Cont.)*

RECOMMENDATIONS

- Increase the impact and reach of pre-college STEM education efforts by leveraging existing investments in university researchers, trainees, and infrastructure.
- Encourage and incentivize STEM outreach by offering supplemental funding to grantee institutions, researchers, and trainees to provide educational outreach, including summer internships, research seminars, science fairs, and hands-on science experiences.

FINDING 5: Untapped potential in NIH's research community *(Cont.)*

RECOMMENDATIONS *(Cont.)*

- Communicate the importance of pre-college student and teacher engagement, especially directed at low SES and underrepresented minorities, as a cultural value of the biomedical research community endorsed by NIH leadership, including all Institute and Center (IC) Directors:
 - Engage pre-college students and teachers in science enrichment activities;
 - Elevate teaching as a career option for trainees; and
 - Provide opportunities for researchers and trainees to provide sustained, long-term mentorship to pre-college students and teachers.

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FINDING 6: Opportunities to partner with others

- Many other governmental agencies are engaged in STEM education:
 - The U.S. Department of Education (ED) and the National Science Foundation (NSF) are responsible for the largest share of federal STEM education programs.
- Numerous STEM efforts are also spearheaded by NGOs, including biomedical and pharmaceutical industry, medical and health research professional societies, and philanthropic organizations .
- As NIH's unique strength is its expertise in biomedical research, the agency needs to seek opportunities to share that expertise.
- By using the leverage of NIH, the varied entities in this space could improve the coordination of their collective efforts with the goal of complementing each other's roles, thus achieving greater impact than working in isolation.

FINDING 6: Opportunities to partner with others *(Cont.)*

- CoSTEM (Committee on Science, Technology, Engineering, and Math Education)
 - Made up of 14 Federal entities
 - Addressing five national goals, including:
 - Improve preschool through 12th grade (P-12) STEM instruction
 - Better serve groups historically under-represented in STEM fields
- NSF and ED are investing in:
 - Building the evidence-base for effective science education interventions
 - Strengthening evaluation approaches
 - Collecting data on primary and post-secondary STEM education

FINDING 6: Opportunities to partner with others

RECOMMENDATIONS

- Seek opportunities to provide expertise and guidance to private and non-profit organizations that support pre-college programs and biomedical science outreach and to learn from them.
- Monitor the subcommittee activities of the National Science and Technology Council's Committee on STEM Education (CoSTEM), in particular the subgroups devoted to improving the diversity of biomedical students and trainees and improving P-12 STEM instruction.

FINDING 6: Opportunities to partner with others *(Cont.)*

RECOMMENDATIONS *(Cont.)*

- Leverage NIH's expertise to support government-wide efforts to improve STEM education and strengthen the evidence base.
- Provide expertise to ED and NSF as they build and implement evaluation standards for STEM programs.
- Partner with ED and NSF to improve data collection at the undergraduate and pre-college level that will be useful for biomedical workforce analysis.

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DISCUSSION & VOTE