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DIRECTORATE FOR
EDUCATION & HUMAN RESOURCES



NSF Dear Colleague Letter 21-033: Advancing Quantum Education and Workforce Development

Webinar #2
June 29, 2021

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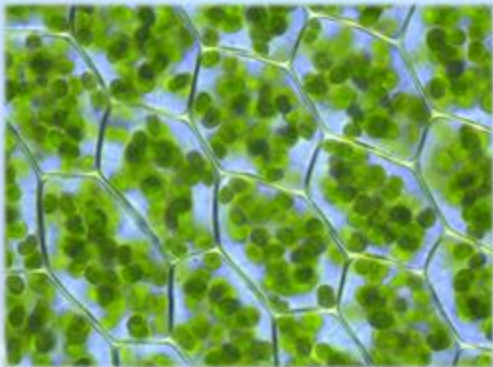
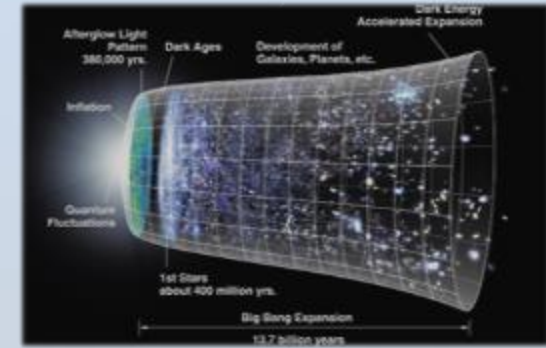
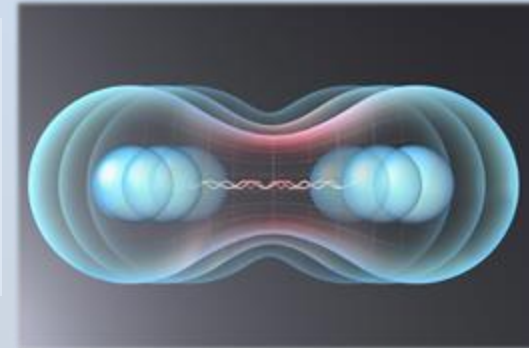


Outline

- **NSF Approach to QISE** (Dr. Tomasz Durakiewicz)
- **Research Experiences for Undergraduates (REU)** (Dr. Corby Hovis)
- **Alliances for Graduate Education and the Professoriate (AGEP)** (Dr. Mark Leddy)
- **Discovery Research PreK-12 (DRK-12)** (Dr. Mike Steele)
- **EHR Core Research (ECR) and Robert Noyce Teacher Scholarship Program** (Dr. Bon Green)
- **Historically Black Colleges and Universities - Undergraduate Program (HBCU-UP)** (Dr. Carleitta Paige-Anderson)
- **National Science Foundation Research Traineeship (NRT)** (Dr. Vinod Lohani)
- **Q & A**

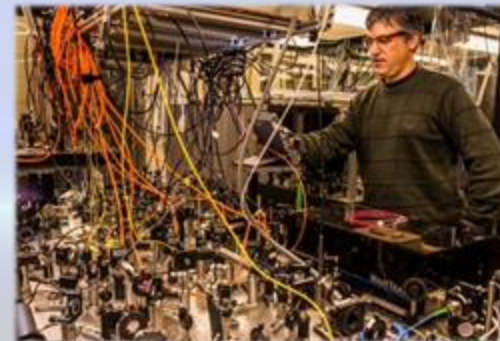
Quantum Leap : Asking Ambitious Questions

Q1: Are there fundamental limits to how far we can push the **entanglement and coherence** frontiers for quantum states? Are there limits in time, distance, or scale?



Q2: What can we learn from quantum phenomena in **naturally-occurring and engineered quantum systems**, including emergent behavior, complexity, quantum-classical boundaries, and their theoretical foundations?

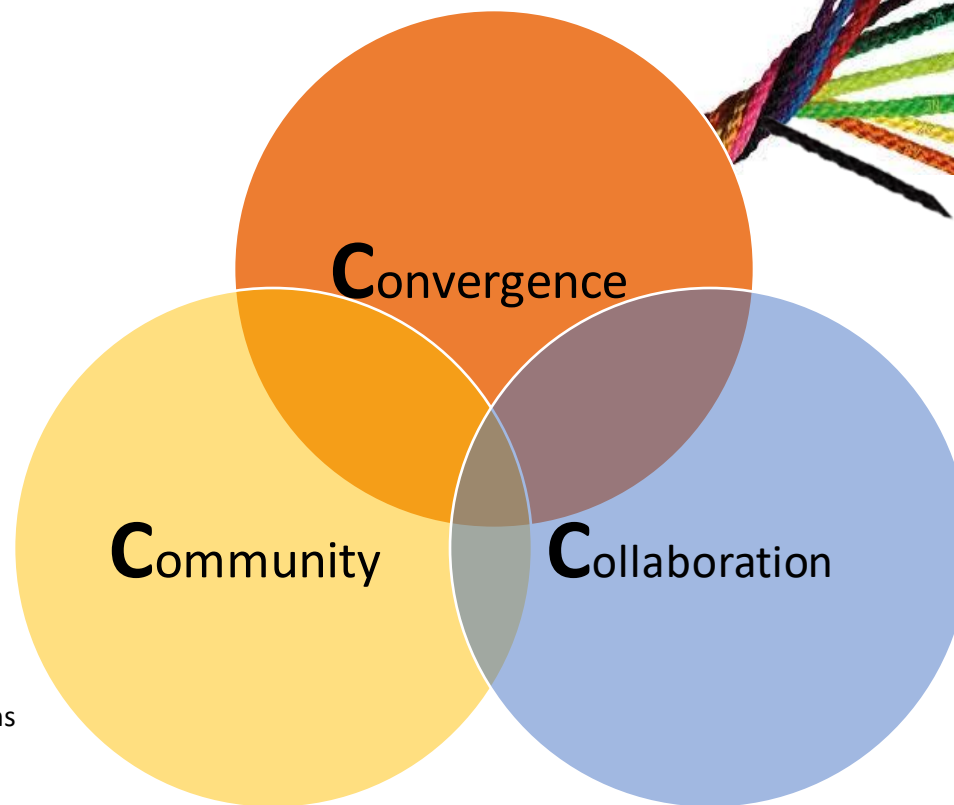
Q3: How do we galvanize the science and engineering **community** to enable quantum devices, systems, and technologies that **surpass classical** capabilities?



Our Approach

The 3 C's

$$\begin{aligned}
 \left| \text{Quantum Workforce} \right\rangle = & c_1 \left| \begin{array}{c} \text{Materials} \\ \text{Researchers \&} \\ \text{Chemists} \end{array} \right\rangle + c_2 \left| \begin{array}{c} \text{Engineers} \end{array} \right\rangle \\
 & + c_3 \left| \begin{array}{c} \text{Physicists} \end{array} \right\rangle + c_4 \left| \begin{array}{c} \text{Mathematicians} \\ \text{\& Computer} \\ \text{Scientists} \end{array} \right\rangle
 \end{aligned}$$



NIST National Institute of Standards and Technology
U.S. Department of Commerce



MEXT
MINISTRY OF EDUCATION,
CULTURE, SPORTS,
SCIENCE AND TECHNOLOGY-JAPAN

Google

IBM



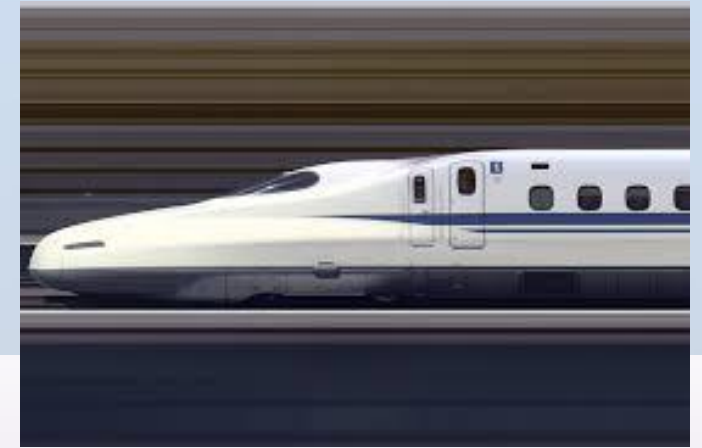
GORDON AND BETTY
MOORE
FOUNDATION



EUROPEAN COMMISSION



All-of-Government Approach: WORKFORCE, EDUCATION AND BROADENING PARTICIPATION



Creating a quantum-smart workforce for tomorrow

Building Quantum Intuition: Quantum intuition is the ability to intuitively differentiate between quantum and classical worlds at the very basic level. **LOWERING THE BARRIERS**

Industry - academia partnerships: recognize required skills and nature of the content specific training that is needed for a diverse workforce. **EFFICIENCY**

Enhancing curricula in all levels of education: early and continued engagement in STEM fields, particularly for underrepresented groups in STEM such as underrepresented minorities and women, is a key factor in retaining and mitigating attrition as students advance to higher grade levels. **INCLUSION AS OPPORTUNITY**

Interdisciplinary programs: mathematical algorithms need to be devised, circuit implementations need to be designed, device function needs to be well understood, devices need to be implemented in functional materials, the local environment needs to be controlled, and structural materials are needed to hold everything together. **CONVERGENCE**

Estimating and tracking future workforce needs: continuing assessment of specific requirements for workforce is vital, especially in a rapidly evolving landscape of workforce needs. **ASSESSMENT**

Government Programs to enhance QIS-ready workforce: supportive of workforce generation goals, with focused efforts undertaken in collaborative mode **LEVERAGE**

Funding Opportunities for K-12 Education

- [Computer Science for All \(CSforAll: Research and RPPs\)](#) **\$20M**
- [Discovery Research PreK-12 \(DRK-12\)](#) **\$64M**
- [Innovative Technology Experiences for Students and Teachers \(ITEST\)](#) **\$30M**
- [Robert Noyce Teacher Scholarship Program \(NOYCE\)](#) **\$58M**

Funding Opportunities for Undergraduate Programs

- [Advanced Technological Education Program \(ATE\)](#) **\$66M**
- [Hispanic Serving Institutions Program \(HSI\)](#) **\$11M**
- [Historically Black Colleges and Universities - Undergraduate Program \(HBCU-UP\)](#) **\$55M**
- [Improving Undergraduate STEM Education Program \(IUSE\)](#) **\$63M**
- [Scholarships in STEM Program \(S-STEM\)](#) **\$95M**
- [The Louis Stokes Alliances for Minority Participation \(LSAMP\)](#) **\$10M**
- [The Centers of Research Excellence in Science and Technology \(CREST\)](#) **\$20M**
- [Tribal Colleges and Universities Program \(TCUP\)](#) **\$12M**

Funding Opportunities for Graduate Programs

- [Alliances for Graduate Education and the Professoriate \(AGEP\) program](#) **\$8M**
- [Innovations in Graduate Education \(IGE\) Program](#) **\$4M**
- [NSF Research Traineeship \(NRT\) Program](#) **\$55M**

Funding Opportunities for All Educational Levels

- [Advancing Informal STEM Learning \(AISL\)](#) **\$39M**
- [EHR Core Research \(ECR\)](#) **\$35M**
- [NSF INCLUDES](#) **\$20M**
- [Research on Emerging Technologies for Teaching and Learning \(RETTL\)](#) **\$19M**
- [Secure and Trustworthy Cyberspace \(SaTC\)](#) **\$69M**

Dear Colleague Letter: Advancing Quantum Education and Workforce Development, NSF 21-033





Research Experiences for Undergraduates (REU) Sites

Corby Hovis, Ph.D.

Directorate for
Education and Human Resources

chovis@nsf.gov



Engaging students in authentic research is one of the most effective ways to attract them to, and retain them in, STEM.



REU Sites Program

- NSF-wide program; all directorates participate
- Current solicitation: NSF 19-582
- Annual proposal deadline: Fourth Wednesday in August
- Encompasses all areas of research normally supported by NSF (including “cross-cutting” and priority areas)
- Online directory of REU Sites (for students):
https://www.nsf.gov/crssprgm/reu/reu_search.jsp



REU Sites

- Award to an organization specifically to support a group of students (typically 8-10) in a research area
- Research area may be a single discipline or an interdisciplinary/multidisciplinary area with a *coherent intellectual theme*
- Each Site designs and runs its student selection process
- Site experiences are usually 9-10 weeks in summer, but academic-year sites are also OK
- Sites provide students with stipend and funds for housing, meals, travel, etc.
- Students:
 - Must be U.S. Citizens, U.S. Permanent Residents, or U.S. Nationals
 - “Significant fraction” must come from outside the host institution
 - “At least half” must come from “academic institutions where research opportunities in STEM are limited (including two-year colleges)”
 - Program encourages recruitment of women, underrepresented minorities, persons with disabilities, veterans, first-generation college students
- Typical grant: \$80k-\$130k per year for 3 years



Typical Features of REU Sites

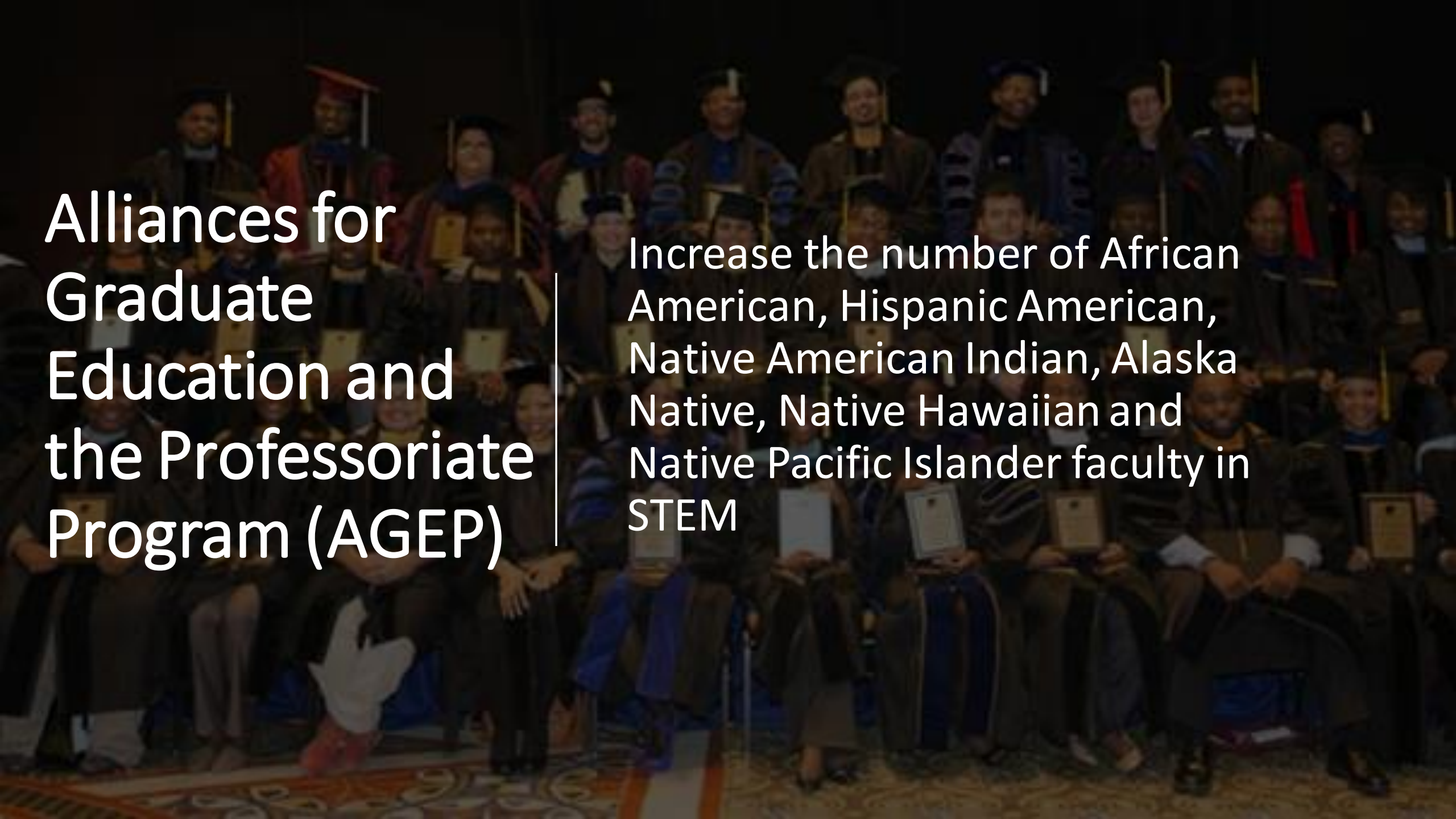
- Students experience cutting-edge research with modern equipment/tools in first-rate facilities/settings
- Activities foster student–faculty interaction, student–student communication, and collegial relationships
- Group activities (mini-courses, seminars, field trips, etc.) contribute to a “cohort experience” for students
- Research mentors (faculty, postdocs, graduate students) are experienced or well-trained in mentoring undergraduates
- Students are involved in designing their research projects
- Students co-author articles, prepare posters, and give presentations at student research symposia and often at regional or national professional meetings
- Students develop...
 - deeper knowledge of S&E
 - understanding of the research process and “culture” of the discipline
 - understanding of career pathways and graduate school in S&E
 - writing, communication, and presentation skills



FY 2021 REU Site Awards Funded Under the Quantum Workforce Development Emphasis

Award #	Institution	PI	Title	Research Areas	Amount
EEC-2046167	U of Arkansas	Weijinya	REU Site: Summer Internships in Nanomaterials, Nanomechanics, and Leadership Training in Engineering	nanoscience, nanoengineering	\$402,533
EEC-2050764	U of North Carolina at Chapel Hill	Cahoon	REU Site: Collaborative Research: Nanoscale Detectives -- Elucidating the Structure and Dynamics of Hybrid Perovskite Systems	hybrid perovskite materials	\$161,232
EEC-2050878	U of Chicago	Ferguson	REU Site: Research Experience for Undergraduates in Molecular Engineering	materials systems for sustainability and health, immunoengineering, quantum engineering	\$434,002
EEC-2050944	U of Pittsburgh	McCarthy	REU Site: Particle-based Functional Materials for Energy, Sustainability, and Biomedicine	material self-healing, controlled delivery of therapeutics, "smart" catalysis, particle separations	\$405,000
DMR-2049188	U of New Orleans	Wiley	REU Site: Advanced Materials Research and Professional STEM Training at the University of New Orleans	catalysis, quantum materials, polymers, nanocomposites, medical materials, environmental remediation	\$404,828
PHY-2051129	Brigham Young U	Van Huele	REU/RET Site: Physics Research at Brigham Young University	quantum information and dynamics, semiconductor nanomaterials, brown dwarfs and transiting planets, coherent lenses imaging and optics, local structure of quantum materials, nanomagnetism, numerical relativity, pulsating star astronomy	\$370,586



A large group of graduates in academic regalia posing for a photo. The graduates are arranged in several rows, some standing and some kneeling or sitting in the front. They are wearing various colored gowns and caps, and many are holding diplomas. The background is dark and out of focus.

Alliances for Graduate Education and the Professoriate Program (AGEP)

Increase the number of African American, Hispanic American, Native American Indian, Alaska Native, Native Hawaiian and Native Pacific Islander faculty in STEM

AGEP Program Home Page

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=54

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Alliances for Graduate Education and the Professoriate (AGEP)

PROGRAM SOLICITATION

NSF 21-576

REPLACES DOCUMENT(S):

NSF 16-552



National Science Foundation

Directorate for Education and Human Resources
Division of Human Resource Development

Letter of Intent Due Date(s) *(required)* (due by 5 p.m. submitter's local time):

June 02, 2021

Letters of Intent are only required for those planning to submit a full AGEP Faculty Career Pathways Alliance Model proposal. Submitting a letter of intent automatically allows you to submit a full proposal to the August 24, 2021 deadline.

June 02, 2022

Letters of Intent are only required for those planning to submit a full AGEP Faculty Career Pathways Alliance Model proposal. Submitting a letter of intent automatically allows you to submit a full proposal to the August 25, 2022 deadline.

Preliminary Proposal Due Date(s) *(required)* (due by 5 p.m. submitter's local time):

February 08, 2022

Second Tuesday in February, Annually Thereafter

Preliminary proposals are only required for institutions of higher education that want to submit a full AGEP Institutional Transformation Alliance proposal.

Full Proposal Deadline(s) (due by 5 p.m. submitter's local time):

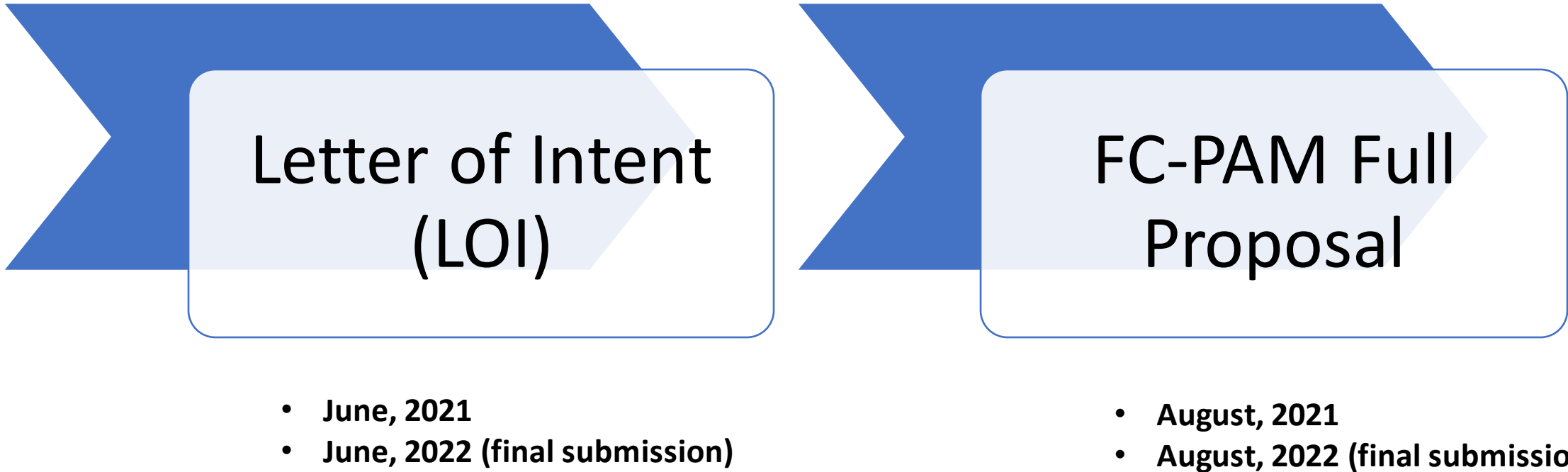
August 17, 2021

Third Tuesday in August, Annually Thereafter

1. Employ approaches that target systemic & institutional change to advance AGEP populations toward tenure & promotion in STEM
2. Partner with similar IHEs to propose a collaborative project
3. Include change agents with relevant expertise as leaders
4. Apply an intersectional lens for project design & change strategies



Faculty Career Pathways Alliance Model (FC-PAM)



Letter of Intent
(LOI)

- June, 2021
- June, 2022 (final submission)

FC-PAM Full
Proposal

- August, 2021
- August, 2022 (final submission)

AGEP Catalyst and Institutional Transformation Alliance Tracks

ACA

- Up to \$400,000
- 2-year collaboration
- 3-4 IHEs
- Project description: 15-page limit
- **August, 2021**
- **August, 2022...**

ITA Preliminary

- At least one IHE must have already received an ACA
- Same 3-4 IHEs as full proposal
- Project description: 8-page limit
- **February, 2022**
- **February, 2023...**

ITA Full

- Must be invited to submit
- Same 3-4 IHEs as preliminary proposal
- Project description: 20-page limit
- **August, 2022**
- **August, 2023...**

Alliances for Graduate Education and the Professoriate Program (AGEP)



Carrie Hall
Program Director
carhall@nsf.gov
703-292-4641



Maurice Dues
Program Specialist
mdues@nsf.gov
703-292-7311



Mark Leddy
Lead Program Director
mleddy@nsf.gov
703-292-4655



Sandra Romano
Program Director
sromano@nsf.gov
703-292-5064

Discovery Research PreK-12

Mike Steele

Program Officer, Division of Research on Learning

Program Lead, Discovery Research PreK-12



Discovery Research PreK-12 Program

Current Solicitation: NSF
20-572

Submission deadline 06
Oct 2021

All future proposals must
be submitted using
[Research.gov](https://www.research.gov) or
[Grants.gov](https://www.grants.gov)

The DRK-12 program seeks to significantly enhance the learning and teaching of science, technology, engineering, mathematics and computer science (STEM) by preK-12 students and teachers, through research and development of STEM education innovations and approaches.



Anatomy of the DRK-12 Program

- STEM education focus
- Formal (classroom) educational settings

Strand

Assessment

Teaching

Learning

Project Type

Exploratory

Design & Development

Impact

Implementation & Improvement

Synthesis

Conference

Funding Level

I: \$450,000, 3 years

II: \$3,000,000,
4 years

III: \$5,000,000,
5 years

Syn: \$600,000,
3 years

Con: \$100,000,
1 year





ECR:Core Research Areas

- Research Area I – Research on STEM Learning and Learning Environments
- Research Area II – Research on Broadening Participation in STEM
- Research Area III – Research on STEM Workforce Development



Proposal Types, Funding Levels, and Duration

- **Proposal Types and Amounts**

- **Level I:** maximum of \$500,000
- **Level II:** maximum of \$1,500,000
- **Level III:** maximum of \$2,500,000

- **Duration**

- 3-5 years any level

Other ECR:Core Proposal Types

- Pilot Studies (Level I only)
- Synthesis Proposals (Level I or II)
- Conferences (\$25K-\$99K)

Other types of funding:

- CAREER (NSF 20-525)
- EAGER (NSF 21-1)
- RAPID (NSF 21-1)



Questions in EHR Core Research?

ECR@nsf.gov

Or visit the NSF EHR Core Research website:

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504924



Robert Noyce Teacher Scholarship Program (Noyce) Goals

[NSF 21-578](#)

Address the critical need for recruiting, preparing, and retaining K-12 STEM teachers and teacher leaders in high-need school districts

Support talented STEM undergraduate majors and professionals to become K-12 STEM teachers in high-need school districts

Support experienced, exemplary K-12 STEM teachers to become teacher leaders in high-need school districts

Support research on the effectiveness and retention of K-12 STEM teachers in high-need school districts



Robert Noyce Teacher Scholarship Program (Noyce)

[NSF 21-578](#)

Track 1: Scholarships and Stipends (S&S)

- Noyce-eligible undergraduate STEM majors and/or STEM professionals
- Up to \$1.2M with a project duration of up to 5 years*

Track 2: NSF Teaching Fellowships (TF)

- STEM professionals
- Up to \$3M with a project duration of up to 6 years*

Track 3: NSF Master Teaching Fellowships (MTF)

- Exemplary, experienced STEM teachers
- Up to \$3M with a project duration of up to 6 years*

Track 4: Noyce Research

- Research on STEM teacher effectiveness and retention in high-need school districts
- Up to \$1M with a project duration of up to 5 years*

Capacity Building (CB)

- Team building, need analysis, & other activities required to develop and submit a proposal to any other track
- Up to \$75K with a project duration of up to 1 year*

*Awards may exceed the budget maximums through Collaboration Incentives for engagement of community colleges in Capacity Building or Track 1 projects, engagement with Noyce awards in Track 4 projects, or engagement with minority-serving institutions in any Noyce submission.



Division of Human Resource Development (HRD)

Human Resource Development (HRD)

HRD programs support and promote activities that seek to strengthen STEM education for underserved communities, broaden their participation in the workforce, and add to our knowledge base about programs of inclusion.

[Read More](#)

AGEP: Alliances for Graduate Education and the Professoriate

ADVANCE: Organizational Change for Gender Equity in STEM

ECR: EHR Core Research and Development (Broadening Participation)

CREST: Centers of Research Excellence in Science and technology

HSI: Improving Undergraduate STEM Education-Hispanic Serving Institutions

EASE: Excellence Award in Science and Engineering

LSAMP: Louis Stokes Alliances for Minority Participation

HBCU-UP: Historically Black Colleges & Universities Undergraduate Program

NSF INCLUDES: Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science

TCUP: Tribal Colleges and Universities Program





WHERE DISCOVERIES BEGIN



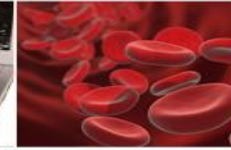
Historically Black Colleges and Universities Undergraduate Program (HBCU-UP)

Goal: To enhance the quality of undergraduate STEM education and research at HBCUs in order to broaden participation in the nation's STEM workforce and STEM graduate programs.

[Solicitation: Historically Black Colleges and Universities Undergraduate Program \(HBCU-UP\) \(nsf20559\) | NSF - National Science Foundation](#)
[Proposal & Award Policies & Procedures Guide - PAPPG | NSF - National Science Foundation](#)



WHERE DISCOVERIES BEGIN



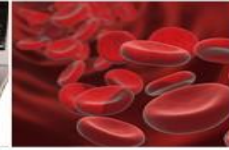
HBCU-UP

Supports development, implementation, and the study of evidence-based, innovative models and approaches to prepare HBCU undergraduates for STEM workforce.

- ✓ Innovation in instruction and curriculum development
- ✓ STEM research experiences for undergraduates
- ✓ Critical transitions (K-12 to undergraduate, 2-year to 4-year, retention from freshman to sophomore, undergraduate to graduate)
- ✓ STEM faculty professional and leadership development
- ✓ Enhance STEM faculty research (RIA, EiR)
- ✓ Research capacity building
- ✓ Broadening participation research in STEM Education
- ✓ STEM teacher preparation



WHERE DISCOVERIES BEGIN



Funding Tracks

- Research Initiation Awards
- Broadening Participation Research
- Targeted Infusion Projects
- Implementation Projects
 - Achieving Competitive Excellence (ACE)
- Broadening Participation Research Centers



WHERE DISCOVERIES BEGIN



HBCU-UP Submission – Deadlines

- Letters of Intent
 - Research Initiation Awards
 - **July 27, 2021**
 - Targeted Infusion Projects, Broadening Participation Research Projects, Implementation Projects, ACE Implementation Projects
 - **September 14, 2021**
- Preliminary Proposals
 - Broadening Participation Research Centers
 - **March 22, 2022**
- Full Proposals
 - Research Initiation Awards
 - **October 5, 2021**
 - Targeted Infusion Projects, Broadening Participation Research Projects, Implementation Projects, ACE Implementation Projects
 - **November 11, 2021**
 - Broadening Participation Research Centers
 - **November 22, 2022**



WHERE DISCOVERIES BEGIN



HBCU-UP: Notable Awards in QISE

Award #: 1601071



Research Initiation Award

Toward Bionanoscience – Binding of
Amino Acids with Graphene and N-
doped Graphene

Award #: 1900710



Research Initiation Award

A Symmetry-Adapted Perturbation
Theory Approach to Reaction Force
Analysis



WHERE DISCOVERIES BEGIN



HBCU-UP Contact Information

Carleitta Paige-Anderson

Program Director and Lead

cpaigean@nsf.gov

Michelle Claville

Program Director

mclavill@nsf.gov

Emanuel Waddell

Program Director

ewaddell@nsf.gov

Toni Edquist

Program Specialist

tedquist@nsf.gov

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National Science Foundation Research Traineeship (NRT) Program

Vinod K Lohani, PhD

vlohani@nsf.gov

Program Director (NRT, IGE, CAREER)

Division of Graduate Education

Directorate for Education and Human Resources

National Science Foundation

Program Officers

Daniel Denecke

Vinod K Lohani

Questions:

nrt@nsf.gov

NSF Webinar for Dear Colleague Letter (NSF 21-033)

June 29, 2021

1:00- 2:30 PM EDT

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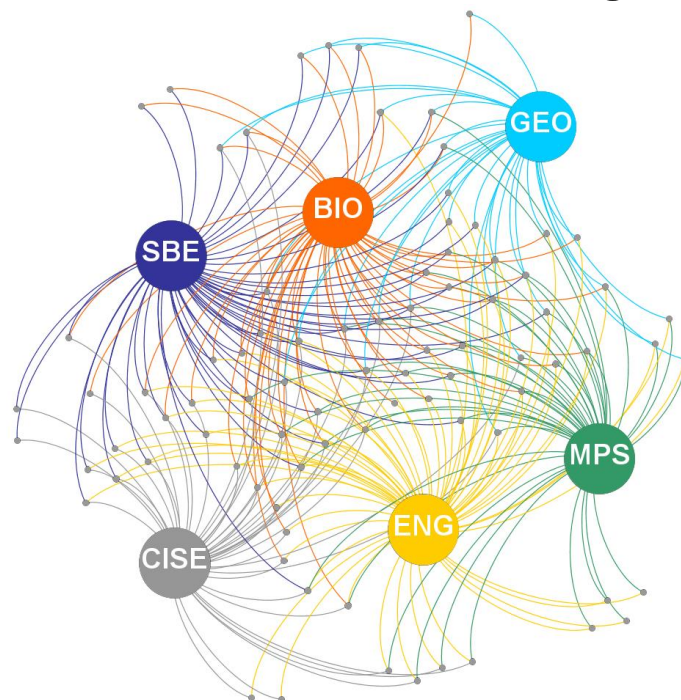
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Questions:
nrt@nsf.gov

NSF Research Traineeship (NRT)

Training the next generation of scientists and engineers to solve convergent, data-intensive societal problems



Key Traineeship Goals

- Interdisciplinary/Convergent Research
- Institutional Change
- Workforce Development
- Current Solicitation: [NSF 21-536](#)



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Program Officers
Daniel Denecke
Vinod K Lohani
Questions:
nrt@nsf.gov

Recent Changes in NRT Program

- A Letter of Intent (LOI) is no longer required
- Two tracks (Track 1 (\$3M) and Track 2 (\$2M))
- AI and QISE was added to priority areas
- 5-10 keywords
- Formal training in teamwork, ethics (in addition to communication that was a part of earlier solicitation)
- Next deadline: Sept. 6, 2021 (NSF 21-536)

Note: R1 institutions are not eligible for Track 2

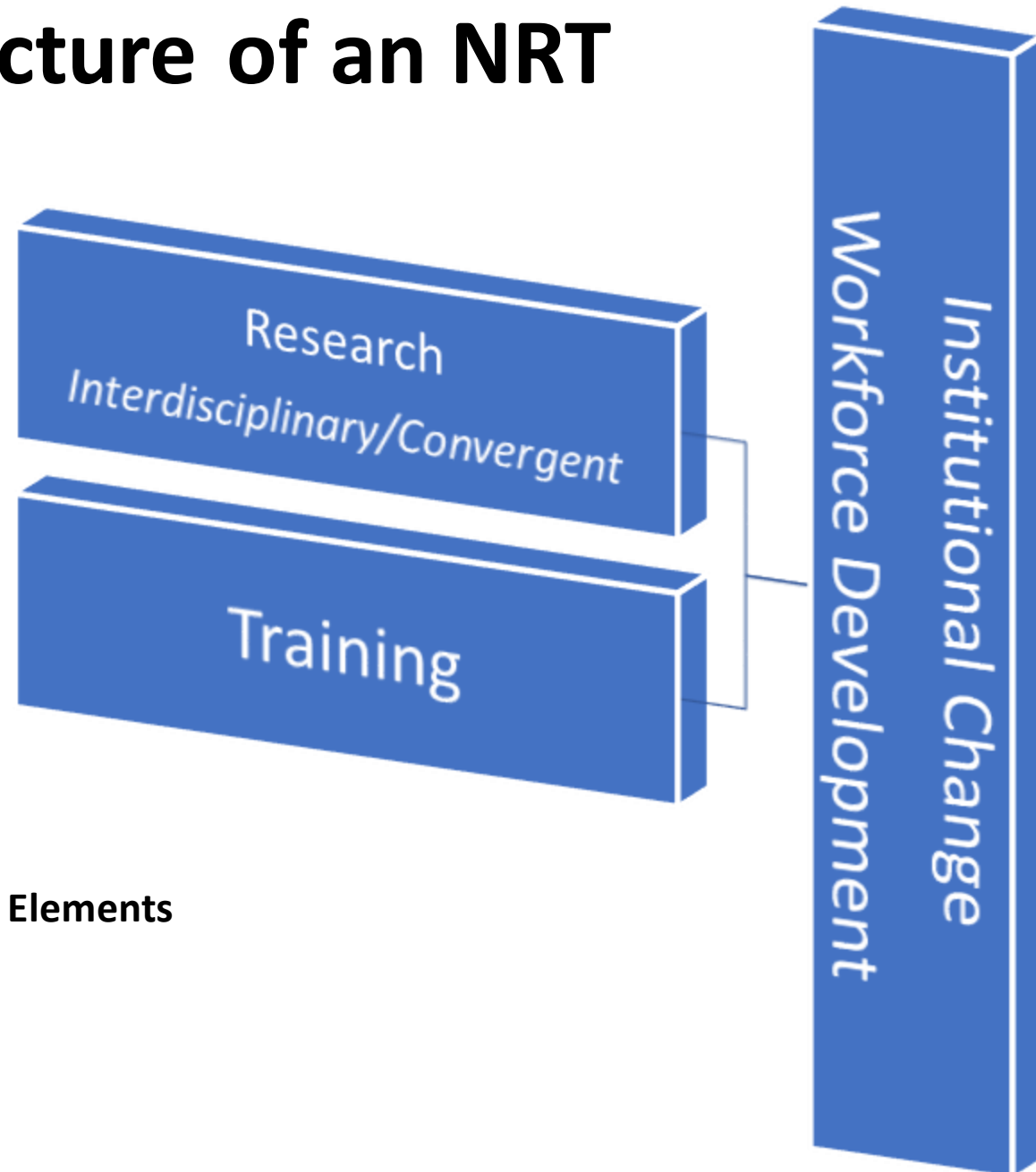
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Vinod K Lohani
Questions:
nrt@nsf.gov

Architecture of an NRT



Other Critical Elements

- Diversity
- Evaluation

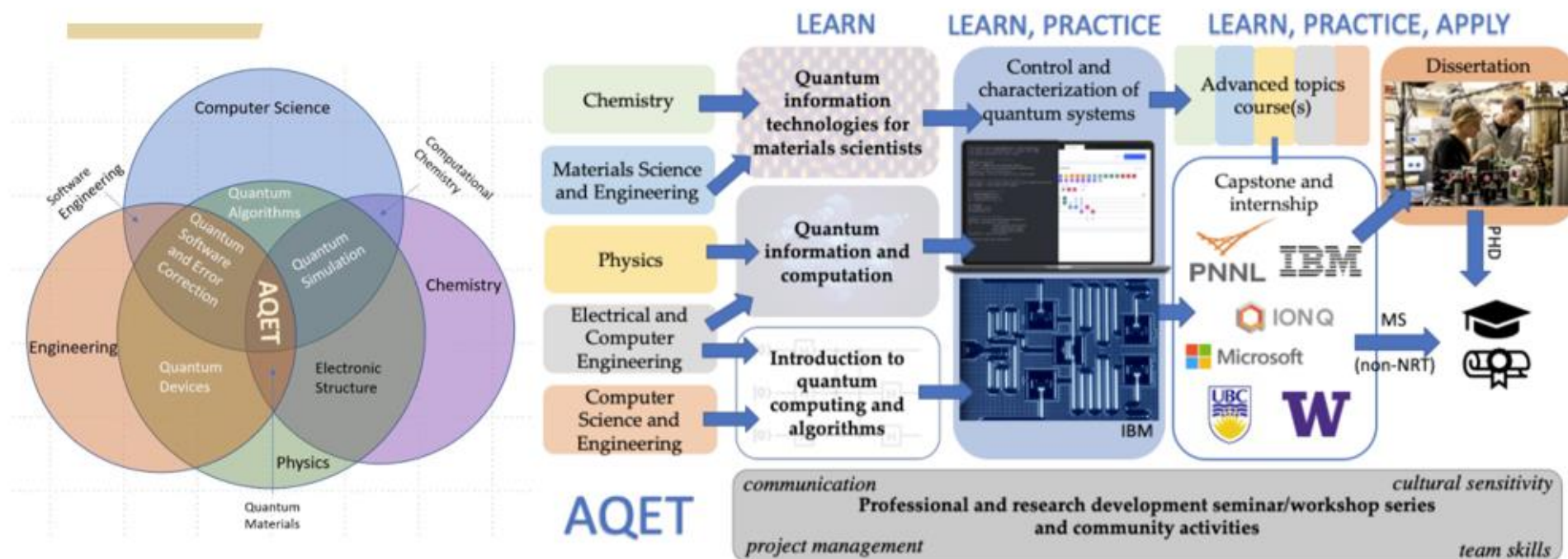
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Example of an NRT Project

NRT:AQET: Accelerating quantum-enabled technologies



UNIVERSITY of WASHINGTON

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Program Officers

Daniel Denecke

Vinod K Lohani

Questions:

nrt@nsf.gov

Thanks for your attention!

vlohani@nsf.gov

and

ddenecke@nsf.gov

Questions and Discussion