Revolutionizing Engineering Departments (IUSE/PFE: RED)

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Webinar Administrative Logistics

- Use Zoom Q&A to submit questions during the webinar.
  - *Kalyn Owens, Program Director, Division of Undergraduate Education (DUE)*
  - *Andrea Ogilvie, AAAS Science & Technology Policy Fellow (EEC)*

- Real-time captions are available within Zoom.

- The presentation slides and webinar recording, including Q&A, will be available on the <u>RED program site</u> as soon as possible following the webinar conclusion.

Webinar Overview

- Welcome from EEC and DUE

- IUSE/PFE:RED Program overview and goals

- Three (3) tracks in new solicitation

- Elements of RED proposals

- Questions from the audience

Welcome

Rosalyn Hargraves

Division Director, Division of Undergraduate Education

Directorate for Education and Human Resources

Jose Zayas Castro

Division Director, Engineering Education and Centers

Directorate for Engineering

IUSE/PFE:RED -- What are those Prefixes?

- IUSE: Improving Undergraduate STEM Education
  - NSF-wide umbrella for all undergraduate STEM education investments
- PFE: Professional Formation of Engineers
  - ENG initiative to understand engineering formation holistically
- RED has many partners
  - Directorate for Education & Human Resources (EHR)
  - All ENG Divisions (CMMI, CBET, ECCS, EEC)

RED addresses the Professional Formation of Engineers (PFE)*

Elements of PFE

- Introductions to the profession at any age.

- Acquisition of deep technical and professional skills, knowledge, and abilities in both formal and informal settings/domains.

- Development of outlooks, perspectives, ways of thinking, knowing, and doing.

- Development of identity as an engineer and its intersection with other identities.

- Acculturation to the profession, its standards, and norms.

PFE: the formal and informal processes and value systems by which people become engineers.

# RED continues its emphasis on revolutionary change!

- ***Radically, suddenly, or completely new***; producing fundamental, structural change; going outside of or beyond existing norms and principles.
- Focus on significant, ***systemic department change.***
- Curricular reform is **NOT** the driver of RED programs. It may be an outcome of RED activities.
- Create a vision for what it means to have an engineering program in your discipline.

RED Focus - The Middle Two Years

Focus on Structural & Cultural Change
- Policies & Practices
- Faculty Development
- Department Culture
- Faculty Culture
- Department Head Role
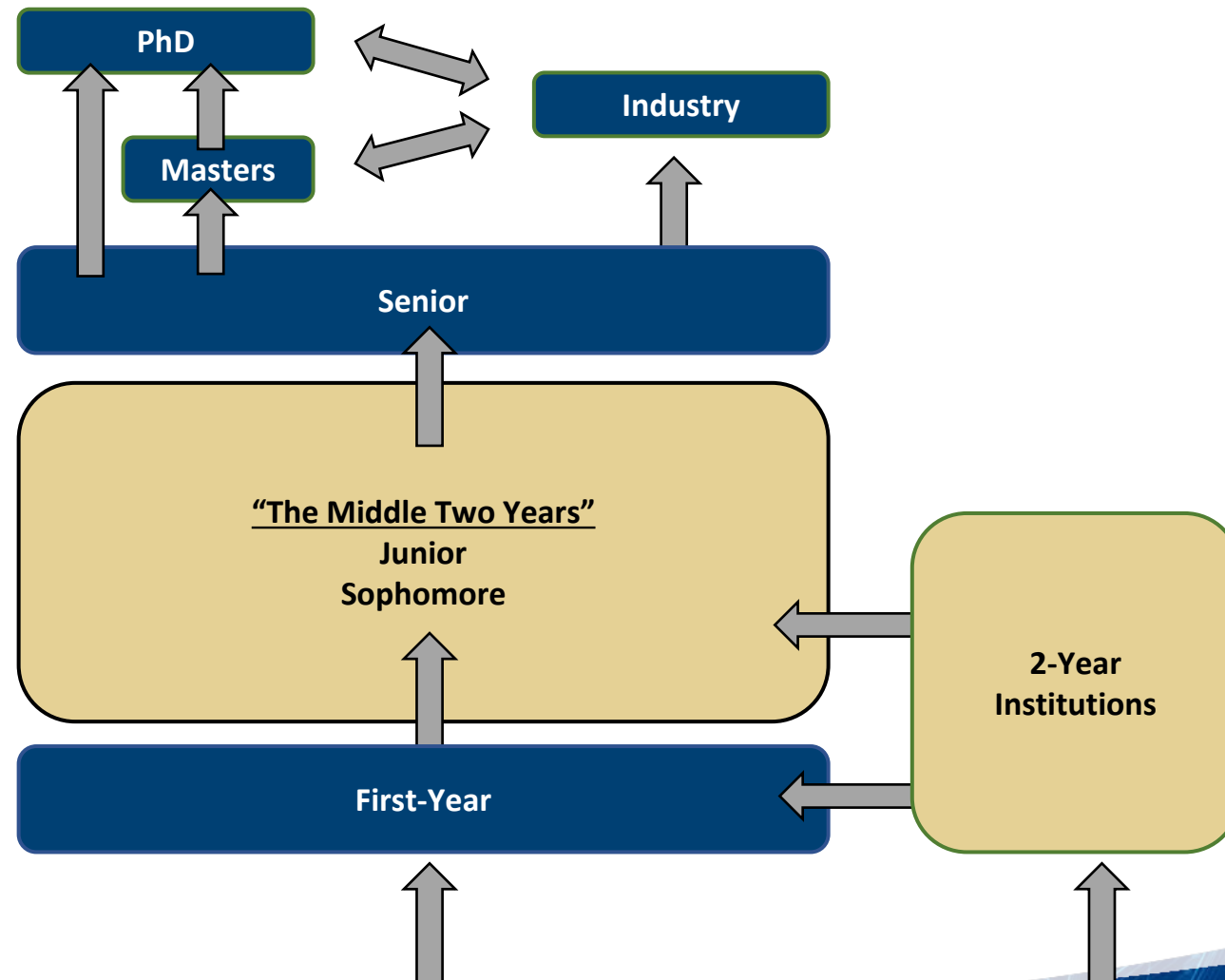
Create a Seamless Educational Experience for Students from Foundational Courses to Capstone Design
- T-shaped Engineers
- 21st Century Skills
- Classroom Experiences
- Curricular Experiences
- Out-of-Class Experiences
- Internships/Co-ops

PhD

Industry

Masters

Senior

"The Middle Two Years"
Junior
Sophomore

2-Year Institutions

First-Year

RED Solicitation Overview (NSF 22-587)

- Catalyze revolutionary approaches in **engineering & engineering technology** departments
- Project Team – Dept Head/Dean (PI) + education researcher + Organizational change researcher
- PI eligibility – Head/chair (individual units) or Dean (college-level efforts)
- Multi-institution Partnerships – Innovation track (Dept. level, optional), Two-Year track (required)

3 Tracks

Innovation

Generate new knowledge

(focus: middle two-years)

PI at 4-year institution

$1M - $3M

Adaptation & Implementation

Adapt proven change strategies

PI at 2-yr or 4-yr institution

$1M

Two Year

Generate new knowledge

(focus: students transferring to 4-year)

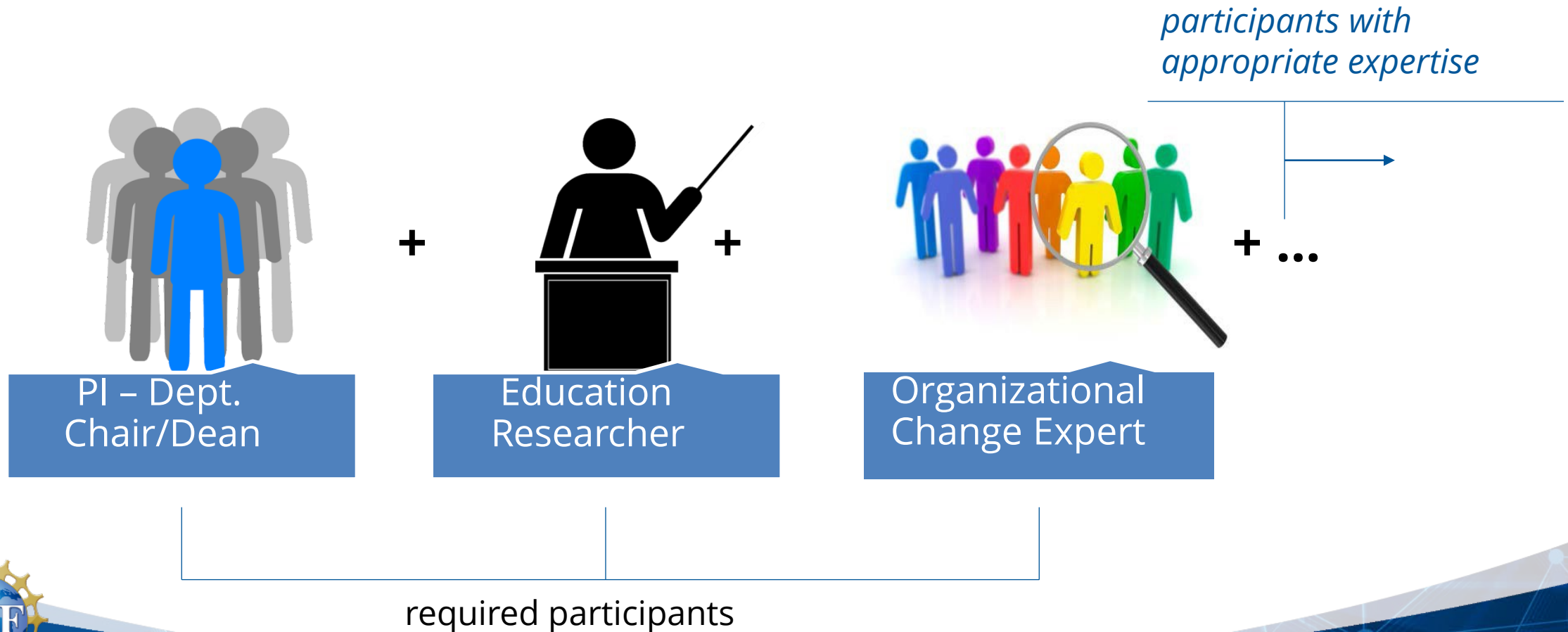*PI at 2-yr institution*

$1M - $2M

Selected changes from prior solicitations

- Two-year institutions are eligible to apply.

- Engineering technology programs eligible to apply.

- Innovation track supports collaboration across departments.

- Proposals should highlight plans for sustainability.

IUSE/PFE: RED Team

The PI for a RED grant MUST be the department head/chair (for individual units) or dean (for college-level efforts). Add other team members whose expertise supports the project's goals.

participants with appropriate expertise

PI – Dept. Chair/Dean + **Education Researcher** + **Organizational Change Expert** + …

required participants

Role of the RED Team members

- Department Chair Head or Dean
  - Serve as Principal Investigator
  - Provide leadership for the change process
- Education Researcher
  - Provide guidance on evidence-based practices
  - Possible departments: engineering educ., educational psychology, CETL, STEM ed.
- Organizational Change Expert
  - Advise on strategies for developing a culture of change and for creating meaningful collective ownership of the effort among faculty, students, and staff
  - Possible departments: organizational psychology, sociology, anthropology, leadership
- Other RED Team Members: Advisory Board, Evaluator, Department Faculty & Staff, Other stakeholders…

RED history

- Throughout RED's history so far, ENG, EHR, CISE funded 26 projects.
- Common threads across these projects: focus on **organizational and cultural change** within the departments, involving students, faculty, staff, and industry in rethinking what it means to provide an engineering program.
- The RED programs are changing department culture and contributing to literature on organizational change--not simply changing curriculum or pedagogy.

Change doesn't <u>start with</u> the syllabus, change <u>shows up</u> the syllabus.

Reminder

Type your questions into the chat box for the Q&A at the end of this webinar. We will answer as many questions as we can.

RED Outcomes for All Tracks

- Fund programs that can serve as exemplars of change.
- Achieve revolutionary change to middle two years of the undergraduate experience.
- Connect engineering education research and practice.
- Contribute to the literature on change.
- Create a cohort of project teams with activities and collaboration within and across cohorts.

Note: A&I Track Proposals

- The innovation to be adapted in your context **can be, but does not have to be**, an outcome from an existing RED project.
- Your evidence-based strategy could be drawn from the literature, your own prior/preliminary work, or some other source.
- Whatever innovation you choose to implement in your context, be sure to describe the **evidence of its effectiveness in its original context**, as well as your argument for **how it will work/be adapted in your context**.

Proposal Elements

Proposal title must indicate track, as noted in the solicitation.

Note: Proposals submitted in response to this program solicitation must be prepared and submitted via Research.gov or via Grants.gov and may not be prepared or submitted via FastLane.

Proposal Sections (see PAPPG NSF 22-1)

- Cover Sheet
- Project Summary
- Project Description
- References Cited
- Biographical Sketch(es)
- Budget and Budget Justification
- Current and Pending Support
- Facilities, Equipment and Other Resources
- Collaborators & Other Affiliations Information
- Special Information and Supplementary Documentation

All information necessary for the review of a proposal must be contained in these sections.

Project Description contents

- Project Plan and Evaluation Framework must contain a section labeled "Broader Impacts"

RED Innovation, RED Two-Year	RED Adaptation & Implementation
• Vision • Goals and Objectives • Specific Actions • Barriers • Advisory Board • **_Research Plan_** • Evaluation Plan • Mentoring Plans • **_Sustainability, Scaling and Adaptation Plan_**	• Vision • **_Rationale and Context_** • Goals and Objectives • Specific Actions • Barriers • Advisory Board • Mentoring Plans • Evaluation Plan • **_Sustainability Plan_** • **_Dissemination Plan_**

Denotes unique section

Vision

- Describe the department(s) and the student professional formation experience "after the revolution."

- How is success defined?

- Provide a concise answer to the question: "What will be different?"

Project Plan and Evaluation Framework

- **Vision**

- **(A&I track only) Rationale & Context:** Why change is needed in current department? How is original implementation being **adapted** to the new context?

- **Goals & Objectives:** Address the cultural, organizational, structural, and pedagogical changes needed to achieve the stated vision. What outcomes and targets at the end of this project will move the department(s) toward the vision? What will **change** about the **department(s), faculty**, and **professional formation of students**?

- **Specific Actions:**
  - **(Innovation & Two-Year)** Describe the activities and interaction between partners (if applicable). What is the **theory of change**; how and why should these activities **effect lasting change**?
  - **(A&I)** How are activities being adapted for success in the new context? What is the **theory of change**; how and why should these activities **effect lasting change**?

Project Plan and Evaluation Framework, pt. 2

- **Barriers:** What are *anticipated barriers* to achieving objectives? What contingency plans are in place?

- **Advisory Board:** Must include external stakeholders and institutional leadership. Who will be included? What will they contribute?

- **(Innovation & Two-Year) Research Plan:** What are your *research questions*? What *educational or sociological theories* inform them? What *methods* answer the research questions posed?

- **Evaluation Plan:** Monitoring of the activities to ensure that the project stays on track and that the desired outputs and impacts are achieved. Matches the scope of proposed work. Based on the theory of change and desirable outcomes of the proposed revolution. Include a logic model. What are the appropriate *indicators of success*? Note: A&I focuses on implementation of the proven strategies in the local context.

Project Plan and Evaluation Framework, pt. 3

- **Mentoring Plans:** How faculty and students will be mentored over the course of this project? Note - Postdoctoral mentoring plan is a supplementary document.

- **(Innovation & Two-Year) Sustainability, Scaling & Adaptation Plan:** How will project efforts be sustained beyond the funding? How will the project make an impact both locally and regionally/nationally by supporting revolutionary change in other departments?

- **(A&I) Sustainability Plan:** How will the team adapt to changes during the project? How will project efforts be sustained beyond the funding?

- **(A&I) Dissemination Plan:** How will knowledge from the adaptation be diffused to other departments and institutions?

Supplementary Documents

- Letters from Institutional Leadership (2 pages max)
  - Dean, Provost or President (as appropriate for project).
  - Must include the individual's name and title below the signature.
- Letter(s) from Other Partners (1 page, max)
  - Clear description of how the partner will participate in the project.
- Letters of Collaboration
- Postdoc Mentoring Plan (if applicable)
- Data Management Plan (including considerations for doing human subjects research (IRB) with FERPA-protected data)

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NSF Merit Review Criteria

Intellectual Merit: The Intellectual Merit criterion encompasses the potential to advance knowledge; and

Broader Impacts: The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

- What is the potential for the proposed activity to
  - Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
  - Benefit society or advance desired societal outcomes (Broader Impacts)?
- To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
- Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
- How well qualified is the individual, team, or organization to conduct the proposed activities?
- Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

Additional Solicitation Specific Review Criteria (see solicitation for details)

- **Vision**
- **PI Team**
- **Institutional Commitment**
- **Connection to Professional Practice**
- **Faculty Development Plan**
- **Potential for Success and Sustainability**
- **Connection to Research on Engineering or Engineering Technology Education**
- **Adaptation and Scaling**

Successful RED Proposals

- **Vision: *How revolutionary*** is the vision in light of a well-grounded understanding of the history, context, and culture of the department?
- **PI Team:** Does the RED team include all required expertise? Are partnerships well described?
- **Institutional Commitment:** Do the letter(s) of commitment provide ***evidence of support*** for the project sufficient to achieve the goals and objectives?
- **Connection to Professional Practice:** Is there a sufficient connection in the proposed project to professional practice?
- **Faculty Development Plan:** Is faculty development well planned and ***properly incentivized*** to build department cultures that support the holistic professional formation of engineers?

Successful RED Proposals

- **Potential for Success and Scalability:** How ***achievable and significant*** are the proposed changes in the ***middle two years*** of the undergraduate experience? How responsive are the changes to the call to focus on ***professional skills***?
  - RED Innovation: Is the *theory of change* valid and well-justified? How well-justified are the *propagation* roadmap/transferability of change strategies?
  - RED A&I: How *reasonable* and *appropriate* is the reach of the dissemination plan?
  - Two-Year: Is the *theory of change* valid and well-justified? How well-justified are the change strategies?
- **Connection to Research on Engineering or Engineering Technology Education**: How well-informed are the vision and execution plan by the literature and ***prior attempts***? Is the expectation of success well-justified?
- **Adaptation & Scaling:** How likely is the new knowledge generated about how to change department culture to be received and utilized by others? How well-conceived are the plans for accomplishing these goals?

Unsuccessful RED Proposals

- Fail to address culture.
- Miss important elements.
  - Structural change using an appropriate theory of change, faculty development, specific institutional commitments, plans for sustainability and scaling
- Explain *what* will be done, but not *how* it will be done.
- Lack appropriate grounding in the literature.
- Present a poor evaluation component.
- Weakly engage education research and/or organizational change expertise on the team.

Frequently Asked Questions

- **How many proposals can be submitted by an institution?**
  - ➤ An eligible institution may submit a maximum of two proposals (e.g. 2 RED Innovation Track or 1 RED A&I Track and 1 RED Two-year Track). An individual may be the PI or co-PI for only one proposal.

- **My institution has a RED project, can I submit a proposal?**
  - ➤ An institution that already has a RED Innovation award can submit a RED A&I proposal to the current solicitation. Institutions that have received RED awards may not submit a proposal to the RED Innovation track.

- **Can computer science departments submit proposals?**
  - ➤ Computer Science departments are no longer eligible to submit proposals to the RED program.

- **Can proposals be submitted from engineering technology departments?**
  - ➤ Yes! We encourage engineering technology departments to submit to the RED program.

- **Can a new department submit a RED proposal?**
  - ➤ Yes. The proposal will need to make a case for radical change versus adaptation and implementation.

Frequently Asked Questions, part 2

- **Can a backbone organization submit a RED proposal?**
  - ➢ For all tracks, the Principal Investigator must be a department chair/head (or equivalent) or Dean to provide leadership for the change process. A backbone organization can participate as additional members of a RED team.

- **Can a four-year institution lead a proposal in the Two-Year track?**
  - ➢ For the RED Two-Year Track, the PI must be at a two-year institution. Two-Year track proposals must partner with other two-year institutions and must collaborate with one or more four-year institutions that they currently transfer students to.

- **Can community colleges apply for the other tracks: RED Innovation and RED A&I? ?**
  - ➢ RED Innovation track is limited to four-year institutions. A&I encourages participation from both two-year and four-year institutions.

- **Can non-credit programs submit a proposal?**
  - ➢ No. US IHEs with associates or baccalaureate engineering or engineering technology degree programs located and accredited in the U.S. are eligible to apply. Two-year engineering technology programs that have articulation agreements with four-year engineering programs are also eligible.

Funded RED awards, by discipline (26 programs)

Discipline	RED programs
Aerospace	Texas A&M
Biomedical	UIUC, Georgia Tech
Chemical	U. of New Mexico[1], Oregon State[2], NC A&T[3]
Civil/Environmental	Clemson, Univ. of Connecticut, Rowan Univ., *Montana State, Georgia Tech*
Electrical/Computer	Colorado State, Embry-Riddle[4], Virginia Tech, Iowa St., Bucknell, U. of South Florida
Industrial/Systems	Embry-Riddle[4]
Mechanical	Purdue, Seattle U., *Texas A&M*
Computer Science[6]	UNC Charlotte[5], UTEP, East Carolina Univ., Boise St.
College of Engineering	U. of San Diego, Arizona St. (Polytechnic School)

Adaptation & Implementation track

[1] UNM is a "Dept. of Chemical & Biological Engineering"

[2] OSU is a "School of Chemical, Biological, & Environmental Engineering"

[3] NC A&T is a Dept. of Chemical, Biological & Bioengineering"

[4] Embry-Riddle is a "Dept. of Electrical, Computer, Software, & Systems Engineering"

[5] UNC Charlotte is a "College of Computing & Informatics"

[6] Computer science programs are no longer eligible for RED awards.

To learn more:

- Read the solicitation (NSF <u>22-587</u>)
- Proposal & Award Policies & Procedures Guide (PAPPG) (<u>NSF 22-1</u>)
- *Common Guidelines for Education Research and Development* (<u>NSF 13-126</u>) - see Foundational Research and/or Early-stage or Exploratory Research
- NSF <u>award search</u> to see what has been funded
- Email Jumoke (Kemi) Ladeji-Osias (JLadejiO@nsf.gov) with questions about your ideas, approaches, team formation, etc. **We urge you to talk to us before writing your proposal.**

Reading List

- RED PI Community resources : 1) Webinar – Assembling a winning RED team? 2) Webinar –Change Model Required, https://academicchange.org/
- Lord, S.M. and Chen, J.C. "Curriculum Design in the Middle Years," Cambridge Handbook of Engineering Education Research, Johri and Olds, eds. New York: Cambridge University Press, 2014.
- Doten-Snitker, K., Margherio, C., Litzler, E. et al. Developing a Shared Vision for Change: Moving toward Inclusive Empowerment. Res High Educ 62, 206–229 (2021). https://doi.org/10.1007/s11162-020-09594-9
- Margherio, C., Doten-Snitker*, K., Williams, J., Litzler, E., Andrijcic, E., & Mohan, S. (2020). Cultivating strategic partnerships to transform STEM education. K. White, A. Beach, N. Finkelstein, C. Henderson, S. Simkins, L. Slakey, M. Stains, G. Weaver, & L. Whitehead (Eds.), Transforming Institutions: Accelerating systemic change in higher education (pp.177-188). Pressbooks.
- National Academy of Engineering 2013. Educating Engineers: Preparing 21st Century Leaders in the Context of New Modes of Learning: Summary of a Forum. Washington, DC: The National Academies Press. https://doi.org/10.17226/18254.

Questions?