stelar

STEM LEARNING AND RESEARCH CENTER

NSF Webinar for Dear Colleague Letter (NSF 23-115): Advancing Microelectronics Education

Hosted by STELAR on behalf of the National Science Foundation

stelar.edc.org

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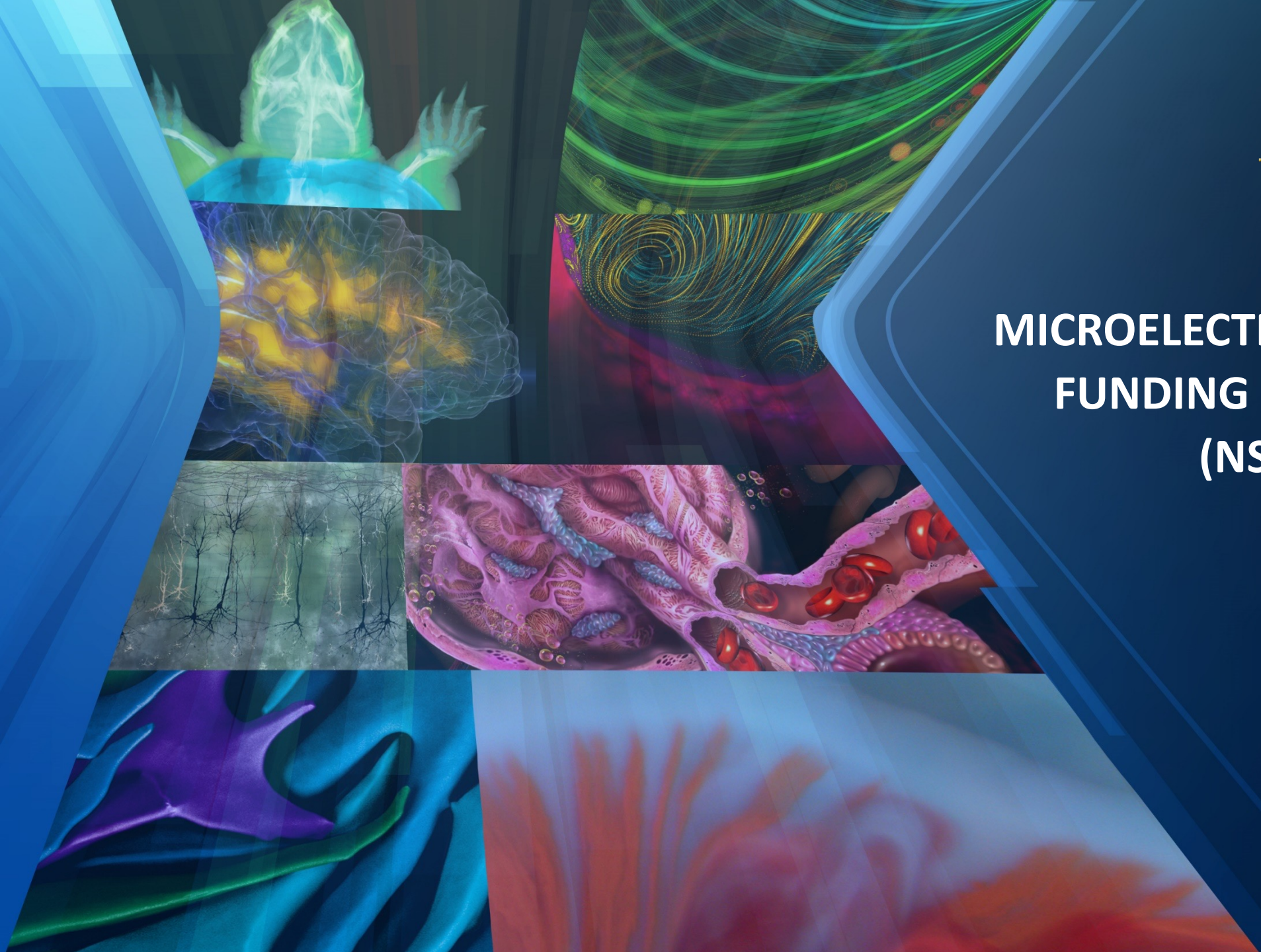


MICROELECTRONICS EDUCATION FUNDING OPPORTUNITIES (NSF 23-115)

Webinar #1
June 6, 2023

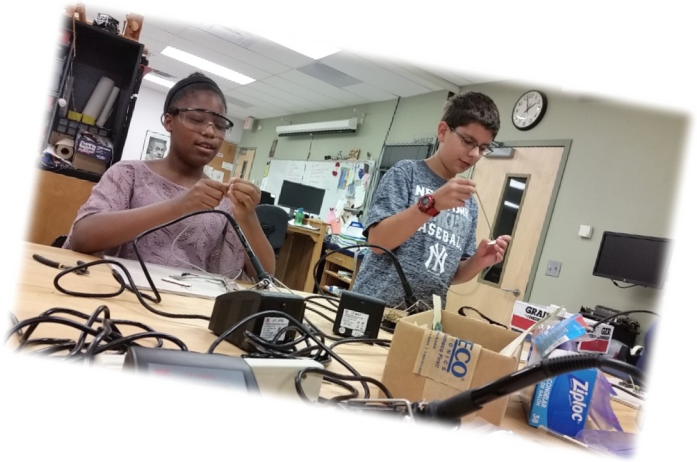
Outline

- **Introduction to the DCL (NSF 23-115)**
- **Advanced Technological Education Program (ATE) (**by Dr. Abiodun Ilumoka**)**
- **Improving Undergraduate STEM Education Program (IUSE) (**by Dr. Abiodun Ilumoka**)**
- **Scholarships in STEM Program (S-STEM) (**by Dr. Abiodun Ilumoka**)**
- **Discovery Research PreK-12 (DRK-12) (**by Dr. Jessaca Spybrook**)**
- **EDU Core Research (ECR) (**by Dr. Eric Knuth**)**
- **Innovative Technology Experiences for Students and Teachers (ITEST)**

  (by Dr. Wu He**)**
- **Robert Noyce Teacher Scholarship Program (NOYCE) (**by Dr. Kathleen Bergin**)**
- **NSF's Eddie Bernice Johnson INCLUDES Initiative (**by Dr. Tori Smith**)**
- **Q & A**

Goal: Excite, motivate and prepare students for participation in the Microelectronics industry of the future in response to the CHIPS and Science Act of 2022 (CHIPS Act)

- US- based leaders in chip-manufacturing technology plan to ramp up domestic production of microchips
- Benefits include:



✓reduce supply chain delays and risks for consumables;
✓promote advanced manufacturing;
✓improve the microchip manufacturing industrial base;
✓galvanize chip design research;
✓create and fill new jobs
✓provide enduring economic and national security benefits

- But

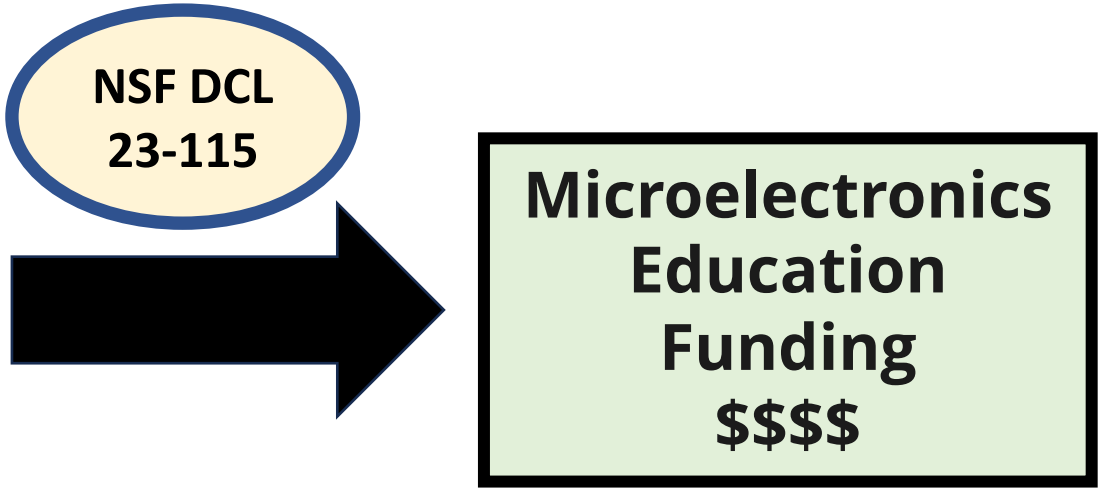
✓Who will design and build the 5nm microchips of the future ?
✓What are the educational needs at the undergraduate level?

Deloitte Insights

Leveraging Existing NSF EDU Programs to Promote Microelectronics Education

1. Advanced Technological Education Program (ATE)
2. Advancing Informal STEM Learning (AISL)
3. Computer Science for All (CSforAll: Research and RPPs)
4. Discovery Research PreK-12 (DRK-12)
5. Improving Undergraduate STEM Education: Hispanic Serving Institutions (HSI) Program
6. Improving Undergraduate STEM Education Program (IUSE)
7. Innovative Technology Experiences for Students and Teachers (ITEST)
8. NSF's Eddie Bernice Johnson INCLUDES Initiative
9. NSF Research Traineeship (NRT) Program
10. Robert Noyce Teacher Scholarship Program (NOYCE)
11. EDU Core Research (ECR)
12. Historically Black Colleges and Universities - Undergraduate Program (HBCU-UP)
13. Innovations in Graduate Education (IGE) Program
14. Scholarships in STEM Program (S-STEM)
15. The Louis Stokes Alliances for Minority Participation (LSAMP)

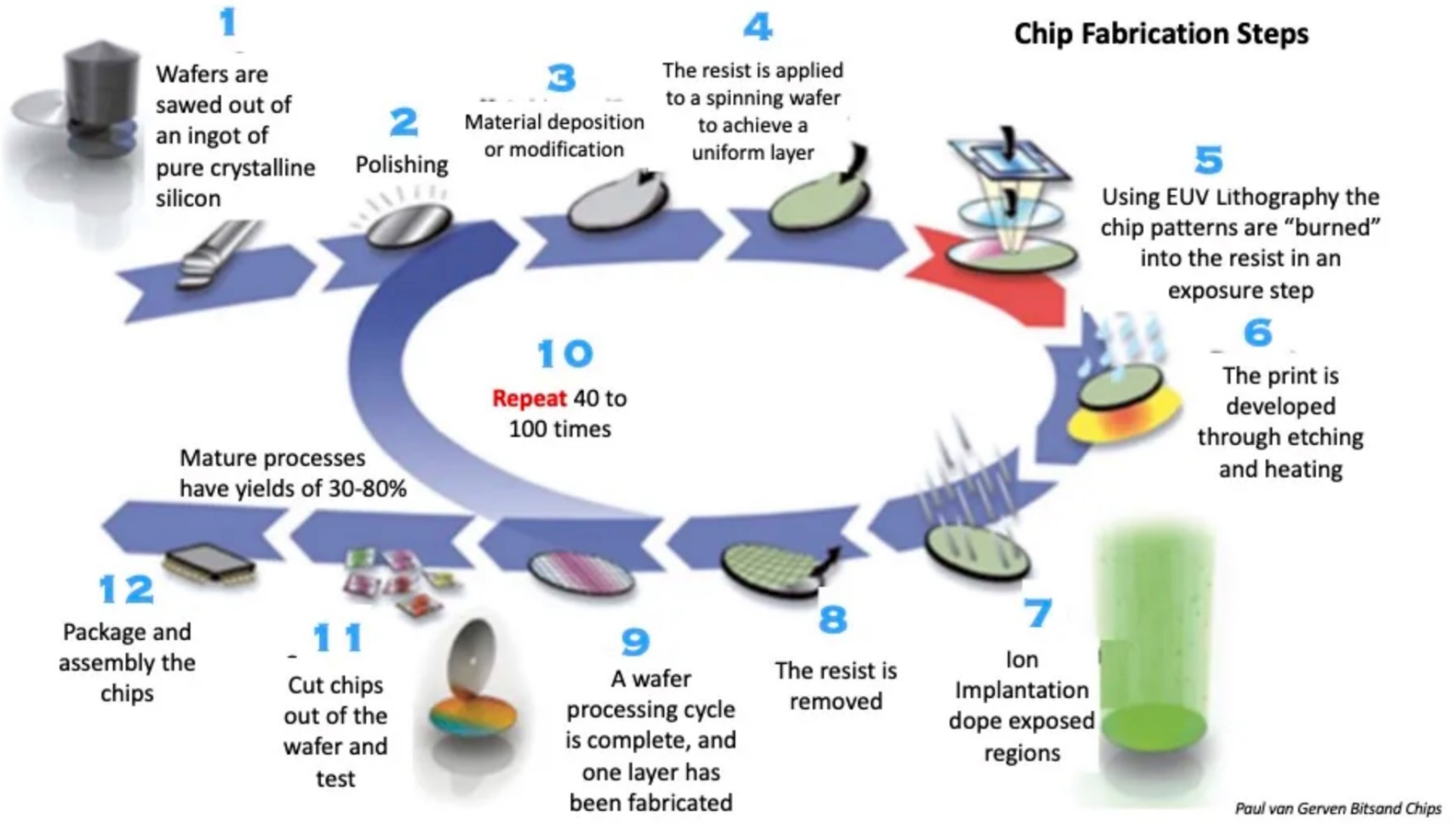
All Academic Levels
Pre-College, Undergraduate, Graduate
Formal, Informal



Microelectronics Education - Challenges & Opportunities

- Human hair is approx 100,000nm wide (there are 25 million nanometers per inch)
- Feature sizes on today's chips less than100nm, shrinking to 10nm-50nm
- AI-powered tools for chip design speed up design process exponentially
- You cannot see what you are making – design of 100 billion electronic devices on one square inch of chip area requires sophisticated software simulation tools and a fertile imagination!
- Microelectronics education requires ability to design, fabricate & test actual devices to verify performance
- Chip fabrication expensive – requires specialized clean rooms, equipment for photo-lithography, e-beam litho, chemical and materials processing and packaging
- Fabrication yields are appallingly low (<20%), multiple steps, many variables…
- Chip performance susceptible to 2nd order effects: RF noise, crosstalk, delay, heat, mechanical defects, etc.
- Chip performance characterization requires expensive specialized test & measurement equipment

Chip Fabrication Steps – Complex Process



https://i0.wp.com/steveblank.com/wp-content/uploads/2022/01/Chip-fab-steps-2.jpg?ssl=1

Microelectronics (μelectronics) Education
Division of Undergrad Education (DUE) Programs
IUSE, ATE, S-STEM

1. Improving Undergraduate STEM Education Program (IUSE)
2. Advanced Technological Education Program (ATE)
3. Scholarships in STEM Program (S-STEM)

μelectronics Education Funding For Undergraduates $$$$

Teaching & Learning Interventions IUSE

Technician Education ATE

Scholarships S-STEM

1. Improving Undergraduate STEM Education

What are IUSE Goals?

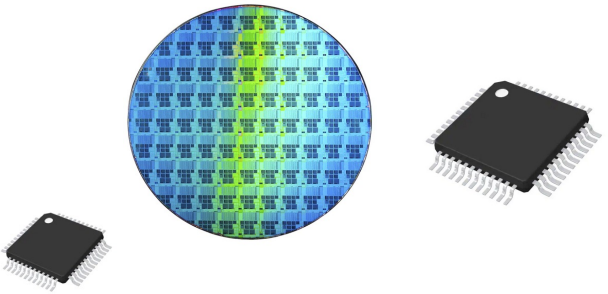
IUSE is a core STEM education program that

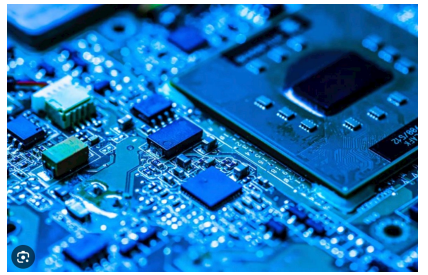
- promotes novel, creative, and transformative approaches to improve STEM education for all undergraduates
- seeks to understand systemic change in undergraduate STEM education
- adapts, improves, and incorporates evidence-based practices into STEM teaching and learning, laying groundwork for institutional improvement in STEM education
- places high value on educating students and faculty to be leaders and innovators in emerging and rapidly changing STEM fields
- places a high premium on educating a scientifically literate public
- generates knowledge through one or more research questions answered via research study OR evaluation of project activities, impacts, or outcomes
- widely disseminates findings
- is open to application from institutions of higher education, professional societies and other non-profit organizations

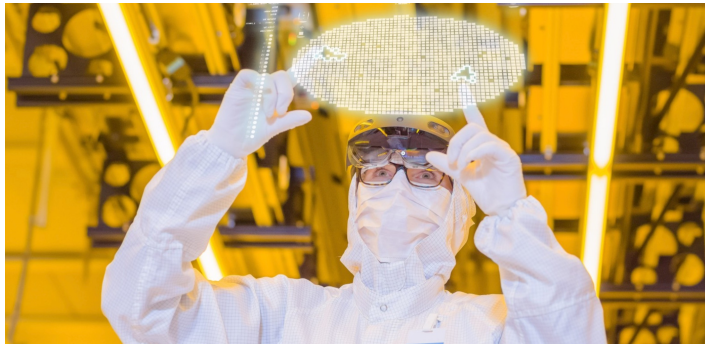
IUSE - Opportunity to Advance Microelectronics Education

Development of a wide variety of teaching & learning interventions

- Adaptive, cutting-edge impactful μelectronics curricula
- Effective sophisticated μchip software design and learning tools
- Imaginative μelectronic instruction techniques with VR, AR, 3D visualization
- Innovative physical and virtual learning experiences in clean rooms and semiconductor fabrication laboratories
- Affordable approaches to μchip characterization - infrastructure for measurement and test equipment
- Strategies for recruitment and training of diverse faculty
- Innovative partnership models with industry to promote learning in μelectronics design, fabrication and test
- Robust strategies for learning assessment







Improving Undergraduate STEM Education (IUSE) NSF 23-510
Annual Budget $92 million (FY22)

Introduce recent advances in µchip disciplinary and interdisciplinary knowledge into undergraduate education

Add to the body of knowledge about what works in undergraduate µelectronics education

Adapt, improve, and incorporate evidence-based practices into µelectronics *teaching and learning*

Lay the groundwork for µchip fab infra-structure improvement

Promote novel, creative, and transformative approaches to generating and using new knowledge about µelectronics teaching and learning
Support development, implementation, and research efforts.

Two Tracks

Engaged Student Learning

Increase Student Enthusiasm, Motivation thru new µelectronics *tools, resources*

Level 1
Up to $400,000
Up to 3 yrs
Deadline 3rd Wed in January

Level 2
$400K to $750K
Up to 3 yrs
Deadline: 3rd Wed in July

Level 3
$750K,001 to $2M
Up to 5 yrs
Deadline: 3rd Wed in July

Institutional and Community Transformation

Propagate highly effective methods of µelectronics *teaching and learning using a Theory of Change. Generating Knowledge about organizational change*

Capacity Building
Up to $200k/$400k
1/2+ institutions
Up to 2 yrs
Deadline 3rd Wed in January

Level 1
Up to $400K
Up to 3 yrs
Deadline 3rd Wed in January

Level 2
$400K to $2M
Up to 5 yrs
Deadline: 3rd Wed in July

2. Advanced Technological Education (ATE) Program

Program Goal: Producing more qualified science and engineering technicians to meet workforce demands and improving technical skills and general STEM preparation of technicians and their educators

What is ATE? A core STEM education program that

- promotes innovation and impact to improve STEM education at 2-year **Institutions of Higher Education**
- focuses on individuals who use a high level of science and engineering skills in their jobs but do not hold a baccalaureate degree
- places high value on educating students and faculty to be innovators in emerging and rapidly changing STEM fields
- improves technical skills and general STEM preparation of technicians and the educators who prepare them
- Promotes diversity, equity, and inclusion in technician education
- Mitigates disproportionate impact of COVID-19 pandemic on two-year colleges

ATE - Opportunity to Advance Microelectronics Education

Development of a range of effective approaches to technician training in µelectronics:

- State-of-the-Art Hands-On Curricula in µelectronics
- Professional development for college faculty and secondary school teachers
- Imaginative µelectronic instruction techniques with VR, AR, 3D visualization
- Innovative physical and virtual learning experiences in clean rooms and semiconductor fabrication laboratories
- Affordable approaches to µchip characterization - infrastructure for measurement and test equipment
- Strategies for recruitment of diverse µelectronics faculty
- Innovative partnership models with industry to promote learning in µelectronics fabrication and test
- Approaches to safety in µelectronics fab and clean rooms

Advanced Technological Education (ATE) Goals & Tracks (NSF 21-598) ($75 million, 45 – 80 awards)

Produce more qualified science and engineering technicians to meet workforce demands

Improve the technical skills and the general science, technology, engineering, and mathematics (STEM) preparation of these technicians and the educators who prepare them

Effective technological education programs should involve partnerships in which **two-year IHE**s work with four-year IHEs, secondary schools, business, industry, economic development agencies, and government

ATE Program Tracks

Track 1: Small Projects for Institutions New to the ATE program has a maximum budget of $350,000 over three years.

Track 2: ATE Projects have a maximum budget of $650,000 over three years. This track supports a diversity of project areas focused on improving the education of the skilled technical workforce, and these projects are usually larger in scope than those proposed under Track 1.

Track 3: New “Consortia for Innovations in Technician Education” has been added. Targets small consortia involving two-year institutions working to strengthen partnerships to accelerate development and dissemination of materials and best practices

Track 4: ATE Centers: integrated approach to technician education. Nexus point for dissemination of critical knowledge & skills

Track 5: Applied Research on Technician Education aims to support applied research in emerging fields (formerly Targeted Research on Technician Educ)

Deadline (All Proposals): Oct 5, 2023

3. S-STEM Program

Program Goals

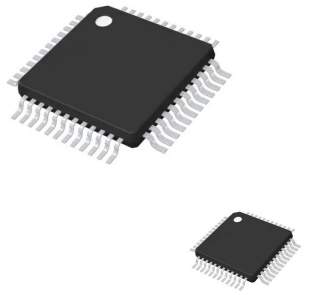
60% Scholarships,
40% Program Support

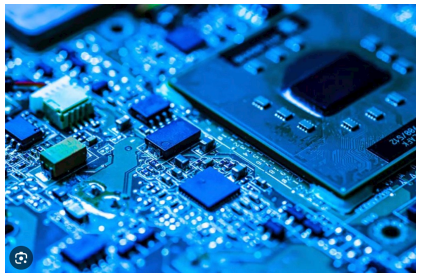
Increase	increase the number of domestic, **low-income, academically talented students** with demonstrated financial need obtaining undergraduate or graduate degrees in S-STEM eligible disciplines and entering the US workforce or graduate programs in STEM
Improve	improve support mechanisms for future scientists, engineers, and technicians, with a focus on **low-income, academically talented students**
Advance	advance understanding of how interventions or evidence-based curricular & co-curricular activities affect success, retention, transfer, academic/career pathways, and graduation of **low-income, academically talented students** in STEM

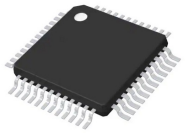
Leveraging S-STEM to Advance Microelectronics Education

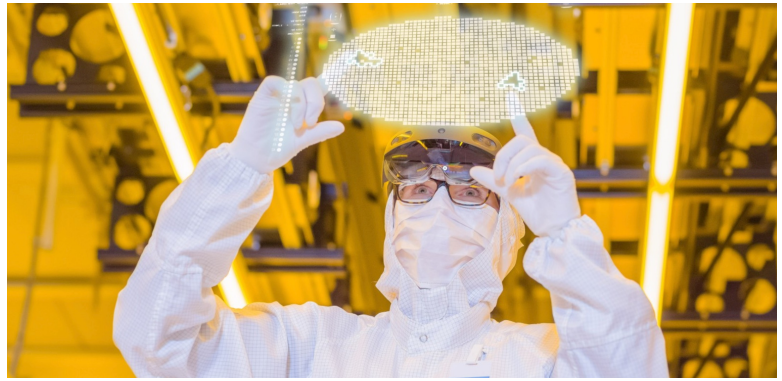
Provision of μelectronics-relevant support structures and activities (40% Program Support):

- Field Trips to semiconductor manufacturing facilities
- Effective industry-based μchip training and internship experiences
- "Tinkering" opportunities in Maker-space like campus learning environments
- Chip design student competitions/clubs for popular applications (e.g. gaming)
- Outreach strategies for recruitment and retention of diverse students
- Innovative partnership models with industry to promote learning in μelectronics design, fabrication and test









Scholarships in STEM (S-STEM) Program Goals & Tracks (NSF 23-527)
($80 - $120 million, 75-90 awards)

Increase number of **financially challenged** academically talented students with demonstrated financial need obtaining degrees in S-STEM eligible disciplines entering **µelectronic** workforce or grad programs

Improve the education of future scientists, engineers, and technicians in **µelectronics**

Generate knowledge to advance understanding of how interventions affect success, retention, transfer, academic/career pathways in **µelectronics**

Collaborative Planning Grants (CPG)

Up to $100K for 1 year

Partnerships: 2 or more IHEs working to establish fruitful collabs in prep for track 3

Institutional Capacity Building (Track 1)

Up to $1 million Up to 6 yrs

No prior S-STEM funding. Limited experience implementing effective curricular & co-curricular activities

Design and Development

(Track 2) Single Institution

Up to $2.5M Up to 6 yrs

(Track 3) Multi-institutional Consortia

Up to $5M Up to 6 yrs

Seeks to leverage S-STEM funds with institutional efforts and infrastructure to increase and understand impacts

Deadlines: Track 1 Mar 28, 2024. Tracks 2, 3 and CPG Feb 20, 2024 (Max 2 proposals per organization)

Discovery Research PreK-12 (DRK-12)

NEW Solicitation 23-596
https://new.nsf.gov/funding/opportunities/discovery-research-prek-12-drk-12

Submission Deadline: November 8, 2023

DRK-12 is the only NSF program whose primary purpose is to support applied research and development at the preK-12 level of ***formal education*** in all areas of STEM.

Objectives:

(1) build knowledge about how to **develop preK-12 students' and teachers' STEM content knowledge, practices, and skills;**

(2) support **collaborative partnerships** among STEM education researchers and STEM education practitioners and school leaders;

(3) **build the field of STEM education** by supporting knowledge **synthesis** and the development of novel and robust **assessments** of teacher and student learning, engagement, and skills.

Outcomes can include promising, evidence-based products and methods that can be used by others to support the success of ***all*** teachers and ***all*** students (e.g., curriculum, teaching and research tools, models of collaboration).

Important Features of New Solicitation

1. **NEW**: Added Partnership Development project type

   up to $100,000 for one year;

   e.g., multidisciplinary workshops, stakeholder meetings, project planning and explorations regarding the positioning and capacity of the team to work together to advance formal PreK-12 STEM teaching and learning.

2. Emphasized a programmatic commitment to research in the Teaching Strand as STEM workforce development.
3. Emphasized dissemination plans as a critical component of knowledge mobilization or the reciprocal exchange/translation of knowledge between fields, stakeholder, etc.
4. Moved *Assessment* from a project Strand to a project Type.
5. Updated all project type descriptions.

DRK-12 Program Structures

Strands

- Teaching
- Learning

Project Types

- Exploratory
- Design & Development
- Impact
- Implementation & Improvement
- Measurement & Assessment
- Syntheses

- **Partnership Development**
- Workshops & Conferences

Funding Levels & Duration

- Level I: up to $450,000, 3 years
- Level II: up to $3,000,000, 4 years
- Level III: up to $5,000,000, 5 years

- Syntheses: up to $600K, 3 years

- Partnership Development, up to $100,000, 1 year
- Workshops & Conferences: up to **$200K**, 1 year

Resources for Current & Prospective DRK-12 PIs

Program Resource Centers

Community for Advancing Discovery Research in Education (https://cadrek12.org)

See the **Proposal Preparation Toolkit**

Evidence Quality and Reach Hub (https://cadrek12.org/eqr-hub)

Offers learning events, services, and resources related to research methods; knowledge translation; and diversity, equity, and inclusion.

Public abstracts of previously funded projects

https://www.nsf.gov/awardsearch/advancedSearchResult?ProgEleCode=7645&BooleanElement=Any&BooleanRef=Any&ActiveAwards=true#results

Contact Us!

Send questions and concept papers, or volunteer to review proposals, by emailing DRLDRK12@nsf.gov

EDU Core Research (ECR)

Solicitation 21-588
Deadline: October 5, 2023

HTTPS://BETA.NSF.GOV/FUNDING/OPPORTUNITIES/EHR-CORE-RESEARCH-ECRCORE

National Science Foundation
Directorate for STEM Education (EDU)

Preparing a diverse STEM workforce and a well-informed citizenry

EDU Core Research (ECR)

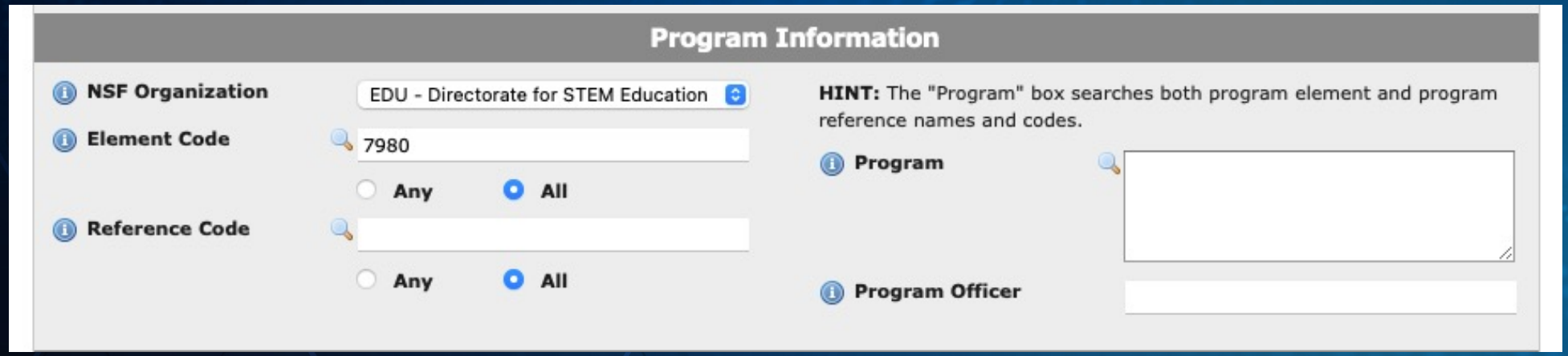
- a fundamental research program that supports both curiosity-driven basic and use-inspired basic research
- supports and encourages multidisciplinary and interdisciplinary approaches to developing foundational knowledge for STEM education
- invites proposals focused on one (or more) of three broadly conceived research areas: *Research on STEM Learning and Learning Environments*, *Research on Broadening Participation in STEM fields*, and *Research on STEM Workforce Development*
- offers three levels of funding, Level I (≤ $500,000), Level II (≤ $1,500,000), and Level III (≤ $2,500,000), and proposals may request a duration of 3 to 5 years for any level

Is my proposed research appropriate for ECR?

- Review the program solicitation
- Review current and/or prior program awards
- Send a 1-page summary of the proposed research to ecr@nsf.gov

What Research does ECR Fund?

- Review current and/or past awards, https://www.nsf.gov/awardsearch/ (select Advance Search)



Collaborative Research: Connecting Professional and Educational Communities to Prepare Construction Engineering Students for the Workplace

Award Number:2201641; Principal Investigator:Abiola Akanmu; Co-Principal Investigator:Sheryl Ball, Walid Saad, Homero Murzi; Organization:Virginia Polytechnic Institute and State University;NSF Organization:DGE Start Date:08/01/2022; Award Amount:$919,837.00; Relevance:64.0;

Virtual Reality to Improve Students' Understanding of the Extremes of Scale in STEM

Award Number:2055680; Principal Investigator:Karen Chen; Co-Principal Investigator:Cesar Delgado, Matthew Peterson; Organization:North Carolina State University;NSF Organization:DRL Start Date:08/15/2021; Award Amount:$886,474.00; Relevance:64.0;

ITEST

An applied research and development program designed to advance the equitable and inclusive integration of technology in the learning & teaching of STEM from pre-K through 12th grade.

Current ITEST Solicitation:
NSF 22-585

Full Proposal Deadline
August 11, 2023
August 09, 2024

ITEST Highlights

- ITEST is responsive to societal needs and emerging areas of STEM and related careers.
- Emerging critical areas include, but not limited to, artificial intelligence, blockchain, cybersecurity, data science, environmental science, quantum information science and engineering, semiconductors and microelectronics, etc.
- ITEST welcomes proposals with well-designed strategies to integrate these emerging areas into effective learning and pedagogical innovations.

Project Types & Funding Levels

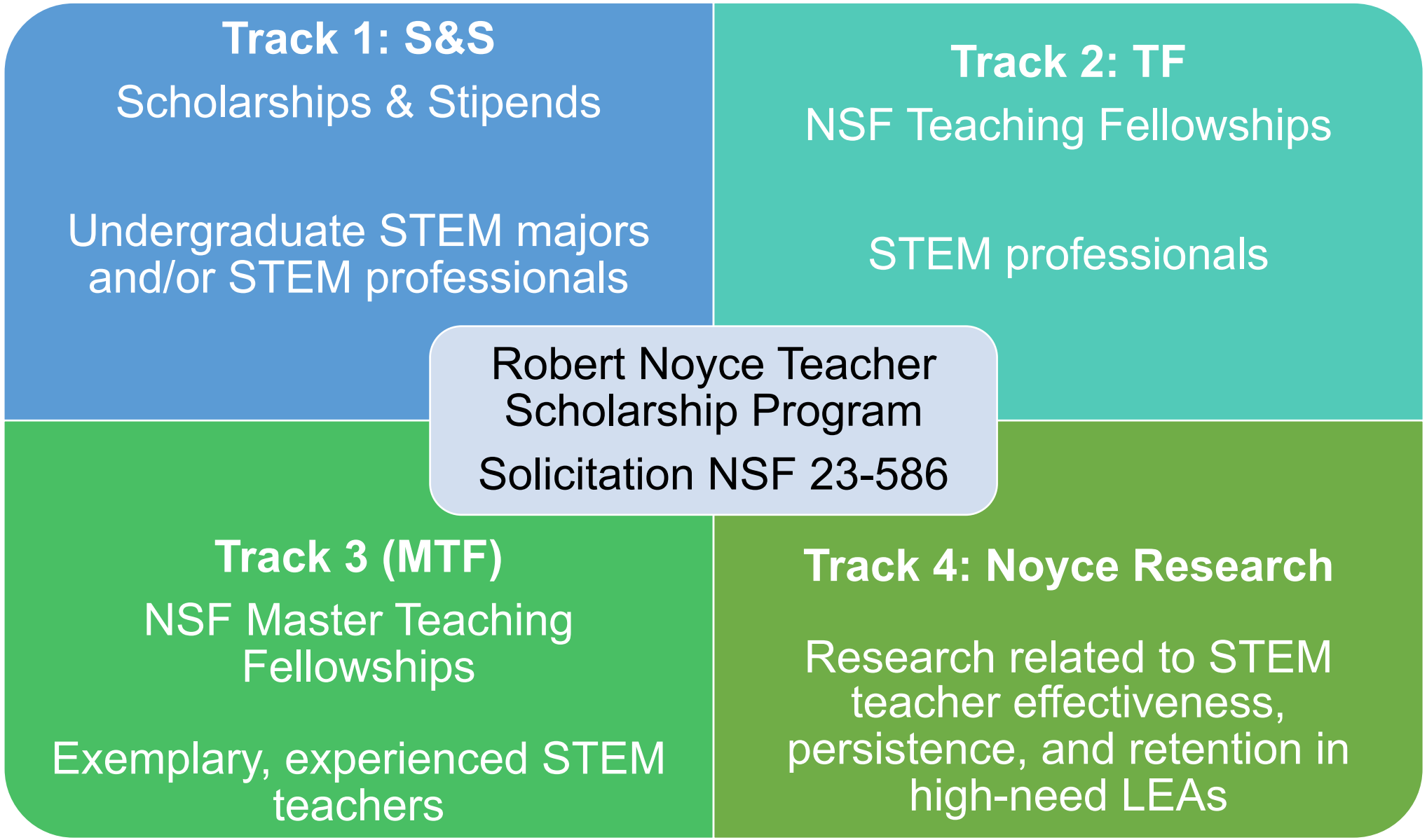
Conference or Workshop Projects	Synthesis Studies	Exploring Theory and Design Principles (ETD)	Designing and Testing Innovations (DTI)	Scaling, Expanding, and Iterating Innovations (SEI)
Up to 1 year	Up to 2 years	Up to 3 years	Up to 4 years	Up to 5 years
Up to $100,000	Up to $400,000	Up to $500,000	Up to $1,300,000	Up to $3,500,000
• Establish timeliness/value to community of the identified issue • Describe expertise and selection criteria for participants • Include conceptual framework • Include draft agenda • Describe expected outcomes & dissemination	• Focus on a question, issue, or topic of critical importance to ITEST pillar(s) • Present current state of knowledge • Explain or justify methods. May include literature reviews, qualitative meta-syntheses, meta-analyses • Generate products useful by researchers and practitioners	• Investigate conditions in the field • Explore factors intended to increase knowledge and interest • Research should build and advance theory, produce design principles or frameworks for innovations	• Design and test or implement the innovation • Analyze outcomes • Research should attend to how the design principles influence knowledge and interest in STEM careers or pathways	• Broaden an innovation at a significant scale • Extend innovation to new populations, regions, ages, contexts • Research should be transferable and generalizable to scale Assess cognitive & soc-emo outcomes, STEM/ICT knowledge & or career pursuit
Proposers should contact a program officer prior to submission.				

ITEST PILLARS

1. **Innovative uses of technologies in teaching & learning**
2. **Partnerships for career & workforce preparation**
3. **Strategies for equity in STEM education**

Note: Each Pillar is required to be discussed in all proposals.

Contact us: Send questions and concept papers, or volunteer to review proposals, by emailing DRLITEST@nsf.gov



*Capacity Building projects, which may lead to the development of full proposals for Tracks 1, 2, 3, or 4 are also supported.

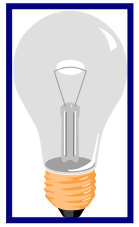
Research Experiences in STEM Settings

Deadline: Anytime, pending Program Officer approval

- ❑ Projects provide research experiences for pre-service and/or in-service STEM teachers.
- ❑ Research experiences should be in formal or informal U.S. Research settings (e.g. national or university labs).
- ❑ The inclusion of individuals from diverse backgrounds is strongly encouraged.
- ❑ Project timelines can vary but are usually 3-5 years.
- ❑ Proposals should describe:
  - The pre-service and/or in-service teacher population that will participate
  - Recruitment and selection processes
  - Planned research and mentoring activities
  - Planned professional development for both teaching and research
  - Desired project outcomes and project evaluation

NSF's Eddie Bernice Johnson INCLUDES Initiative (by Dr. Tori Smith**)**

Proposal Review Process and Timeline



Organization submits via Research.gov

NSF Program

Ad hoc

Advise

Panel

Program Officers

Recommend

Division Director Concur

DGA

Award

Decline

Organization

Proposal Receipt at NSF

6 Months

DD Concur

30 Days

DGA Award

NSB Report on Merit Review Criteria:

Two Review Criteria

When evaluating NSF proposals, reviewers consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits would accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers evaluate all proposals against two 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.

If you want to be a reviewer for microelectronics education proposals, send a brief overview of your expertise & CV or biosketch to: ***edu_chips@nsf.gov***

Questions and Discussion