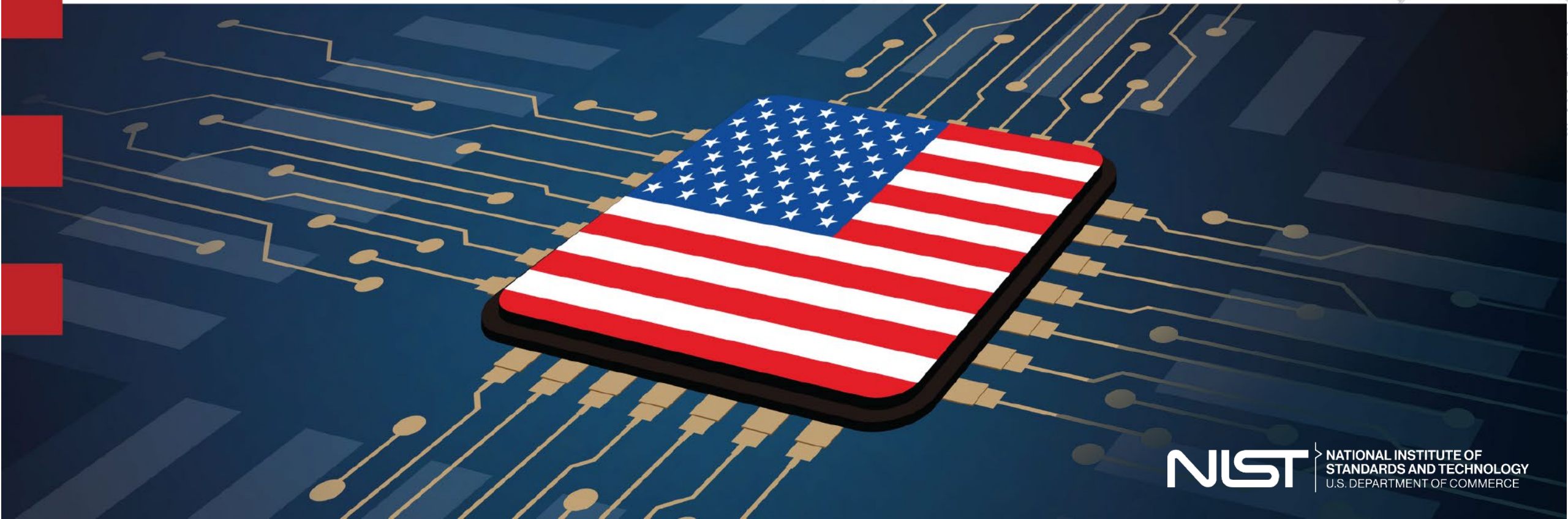
# CHIPS for America
# Leveraging Federal Opportunities for CHIPS Talent Development

May 3, 2023



# Today's Speakers

**Kylie Patterson**
CHIPS Senior Advisor for Opportunity & Inclusion

**Christine McGinn**
CHIPS R&D Workforce Development Liaison

**Rodney Petersen**
CHIPS R&D Education and Workforce Advisor

**James L. Moore III**
Assistant Director, NSF Directorate for STEM Education

**Corby Hovis**
Program Director, NSF Directorate for STEM Education

# Objectives

- Review several of the key workforce semiconductor initiatives being developed and currently available across the federal government
- Help the semiconductor industry and potential workforce partners understand how to participate in these efforts

1. CHIPS Incentives Program
2. CHIPS R&D Program
3. National Science Foundation Programs

# CHIPS for America

## Department of Commerce

### $39 billion for manufacturing

Two component programs:

1. Attract large-scale investments in advanced technologies such as leading-edge logic and memory
2. Incentivize expansion of manufacturing capacity for mature and other types of semiconductors

### $11 billion for R&D

Four integrated programs to:

1. Conduct research and prototyping of advanced semiconductor technology
2. Strengthen semiconductor advanced test, assembly, and packaging
3. Enable advances in measurement science, standards, material characterization, instrumentation, testing, and manufacturing

### $2.7 billion

CHIPS initiatives from other agencies, including DOD, State, NSF, and Treasury

$200 million for NSF CHIPS for American Workforce and Education Fund to kick start development of the domestic semiconductor workforce

# CHIPS for America

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| --- | --- | --- |
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Workforce development

# Workforce Development Vision

Delivering on our **national and economic security objectives** demands **major investments in the semiconductor workforce** that will support **good-paying jobs across the industry.**

**America's diversity is a comparative advantage**; we must make significant investments to create opportunities for **Americans from historically underserved communities**.

Effective workforce solutions **enable key stakeholders to work together.**

# First funding announcement February 28, 2023

# Priorities

- Catalyzing private investment
- Protecting taxpayer dollars
- **Building a skilled and diverse workforce**
- Engaging with U.S. partners and allies
- Driving economic opportunity and inclusive economic growth

# Facility Workforce Plan Provisions in the NOFO

Workforce plans should be developed with partners

Facility workforce plans should have 5 components:

1. Workforce needs assessment
2. Worker recruitment and retention
3. Good Jobs Principles approach
4. Workforce training and wraparound services
5. Metrics and milestones

Commitment to supporting long-term, cross-cutting initiatives

# The Workforce Development Guide helps applicants think through the best models for them and submit strong workforce plans

1. CHIPS Workforce Values

2. Partnerships

3. Facility Workforce Plan


4. Construction Workforce Plan

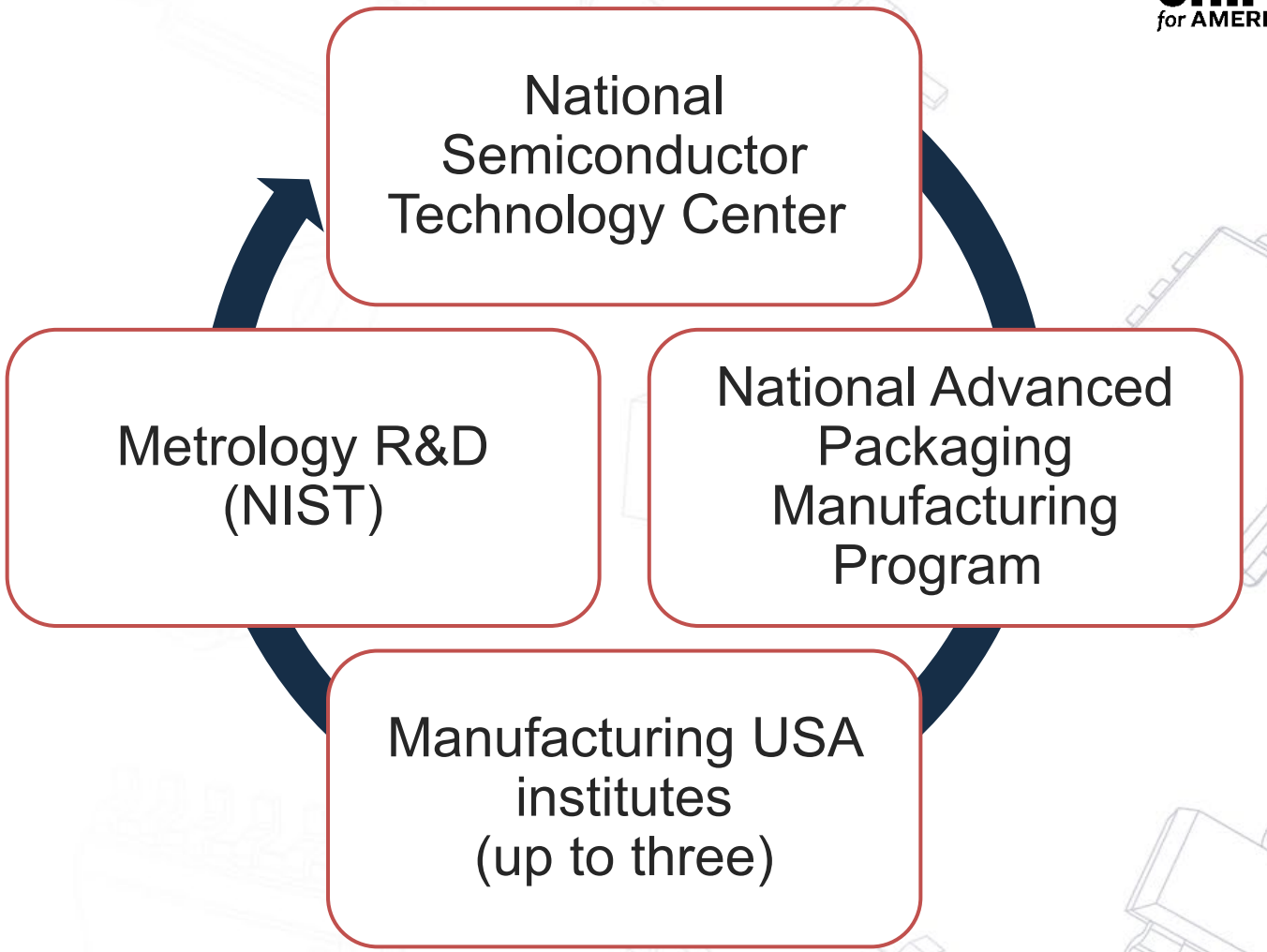
5. Child Care Plan

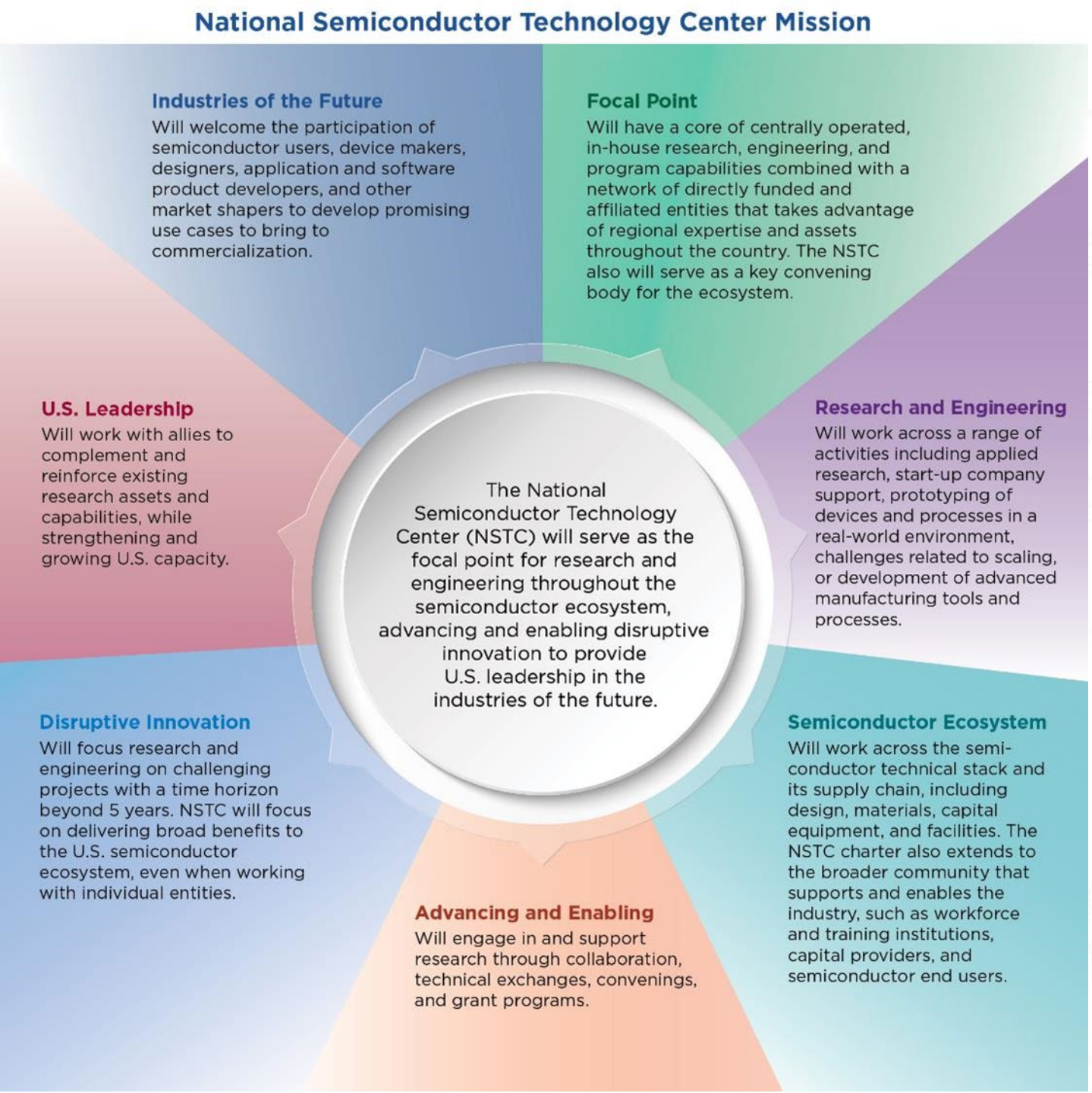
6. Guidance on Submitting Successful Plans

Appendix & Resources

# CHIPS for America R&D

- Strengthen and advance U.S. leadership in R&D
- An integrated ecosystem that drives innovation
- In partnership with industry, academia, government, and allies
- Informed by the Industrial Advisory Committee
- Workforce development efforts in each entity



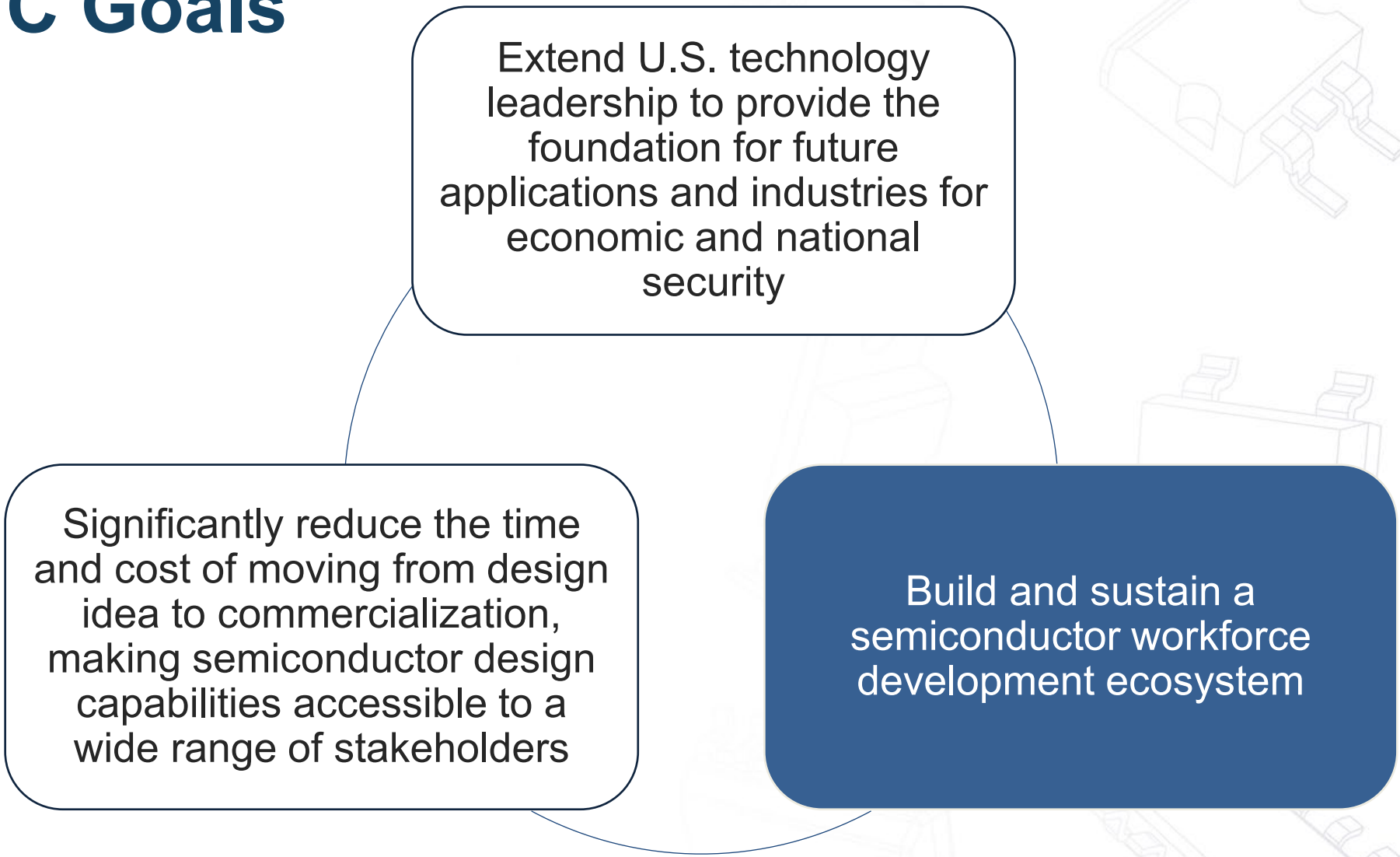



CHIPS for AMERICA

# The National Semiconductor Technology Center

**will serve as the focal point for research and engineering throughout the semiconductor ecosystem, advancing and enabling disruptive innovation to provide U.S. leadership in the industries of the future.**

# NSTC Goals

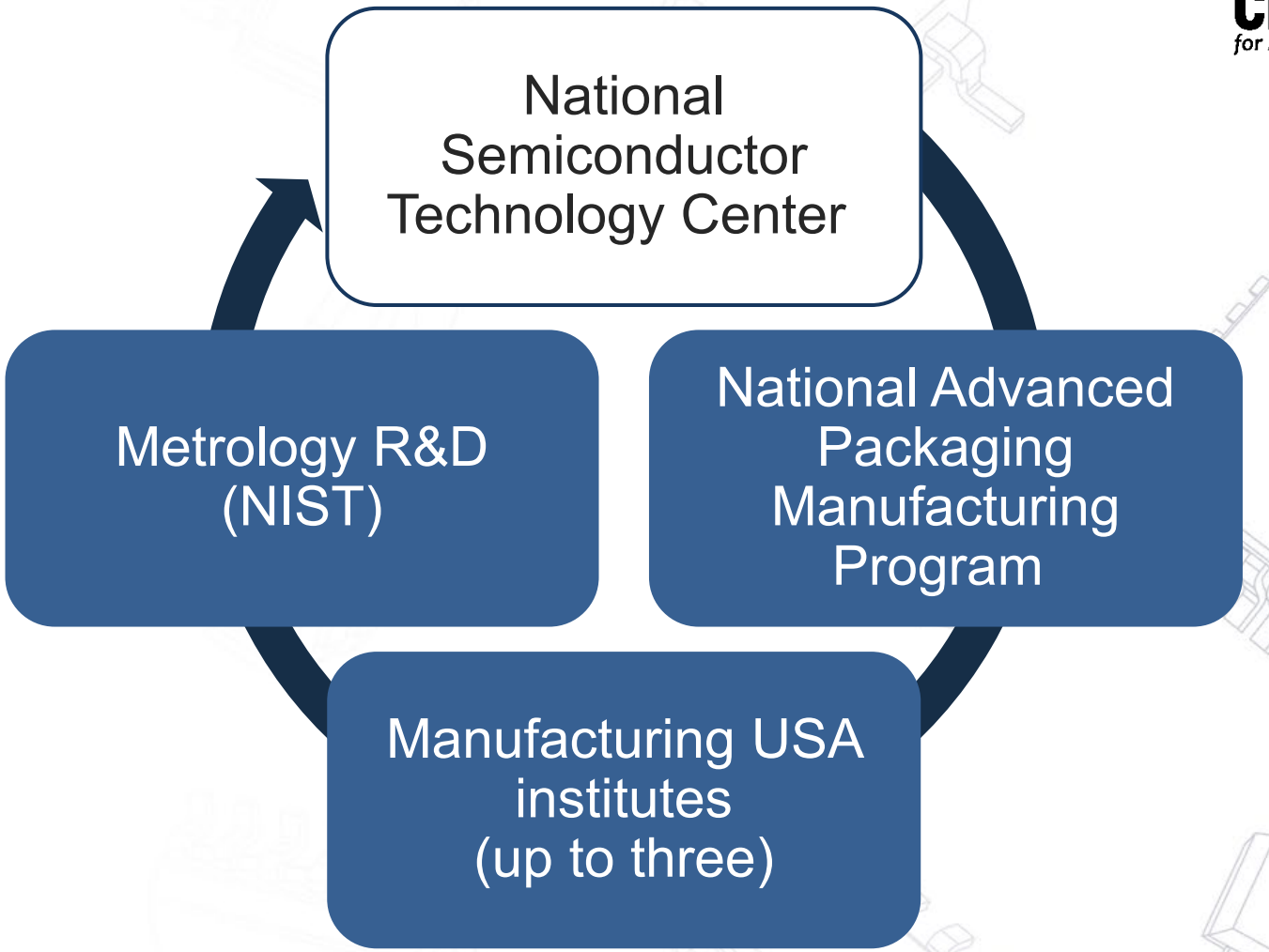

Extend U.S. technology leadership to provide the foundation for future applications and industries for economic and national security
Significantly reduce the time and cost of moving from design idea to commercialization, making semiconductor design capabilities accessible to a wide range of stakeholders
Build and sustain a semiconductor workforce development ecosystem

# NSTC Programs

| | |
|---|---|
| Technology leadership | • Grand challenges and roadmaps, and standards and protocols<br>• Technical exchanges and advisors<br>• In-house and funded research<br>• Investment fund<br>• Security |
| Community assets | • Technical centers for prototyping, research, and experimentation<br>• Chiplets<br>• Design Enablement Gateway<br>• Data sets, multi-project wafer program<br>• Patents |
| Workforce programs | • Identify and scale gold-standard education models<br>• Information clearinghouse<br>• Career guidance, including for underserved populations |

# Workforce is Critical to CHIPS R&D

Training in real-world and cutting-edge capabilities



# Manufacturing USA & CHIPS

## EMPOWERING THE ADVANCED MANUFACTURING WORKFORCE

**>106,000** Workforce and training participants

**$35.4M** EWD investments in 142 institute projects and activities

**79,229** Students participated in institute projects or internships and training

**23,059** Workers completed certificate, apprenticeship, or training program

**4,037** Teachers or trainers completed institute-led training

FY22

# Manufacturing USA Institutes drive education and workforce development for new advanced manufacturing industry needs

*Our goal is to find the hidden gems, with drive, passion, and discipline, and give them the opportunity to succeed.*

- Building the skilled workforce via returning veterans
  - 200,000 returning veterans yearly, a unique resource for the U.S.
  - For semiconductor fabs, the working environment mandates discipline, similar to the military
  - Example: LIFT's Operation Next
- Building the skilled workforce via outreach to underserved communities and underrepresented populations
  - Example: NIIMBL eXperience with MSIs and HBCUs
- Leveraging partnerships with national and regional organizations, industry, community colleges, and universities

# Anticipated Resources for Education and Training Providers

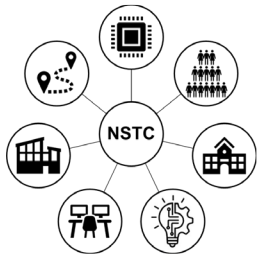
- NSTC expected to offer grant opportunities for workforce development, including opportunities for research and educational infrastructure
- Facility access at CHIPS R&D entities for research and experiential learning
- Increased opportunity for research collaboration, including industry partnership, through CHIPS R&D entities, especially NSTC, MFG USA, NIST Metrology
- CHIPS R&D entities provide opportunity for collaboration on development of curricula focused on in-demand industry skillsets

# Opportunities for Incentives Applicants in CHIPS R&D

- Join the NSTC to participate in workforce programs, including grant applications, to support a long-term semiconductor workforce ecosystem
- Participation in Manufacturing USA institute(s) research and workforce development programs to facilitate training of industry-ready workforce

# CHIPS R&D EWD Goals

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
U.S. DEPARTMENT OF COMMERCE




ManufacturingUSA®

- Strengthen local partnerships focused on EWD to support semiconductor career pathways
- Identify opportunities for scaling of effective programs to meet Secretary Raimondo's stated goal of 3X graduates in semiconductor-related fields in the next ten years
- Create resources that lower barrier to entry and broaden participation in semiconductor-related fields
- Expand outreach about semiconductor opportunities in local communities

# NSF investments in semiconductor workforce development

James L. Moore III
Assistant Director
Directorate for STEM Education

Corby Hovis
Program Director
Directorate for STEM Education

*CHIPS for America Webinar: "Leveraging Federal Opportunities for CHIPS Talent Development"*

# National Science Foundation

*"To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense...."*

—NSF Act of 1950

# NSF by the numbers

| | |
|---|---|
| 1950 | Year Congress created NSF |
| $9.9B | NSF's FY 2023 Enacted Budget |
| 93% | Percent of budget committed to research, education, and related activities |
| 11,000 | Average number of awards NSF funds each year |
| $255M | Amount that NSF awards annually to businesses to move discoveries into the marketplace |
| $1.6B | NSF's annual investment in STEM education |
| 258 | Number of Nobel Prize winners who have received NSF funding |

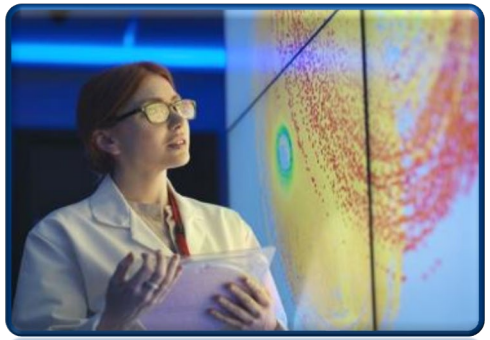
## People Involved in NSF Activities, FY 2022

| | |
|---|---|
| Senior Researchers | 52,747 |
| Other Professionals | 13,473 |
| Postdoctoral Associates | 6,062 |
| Graduate Students | 43,615 |
| Undergraduate Students | 39,241 |
| K-12 Teachers | 41,862 |
| K-12 Students | 139,070 |
| Total: | 336,070 |

# Support for activities across stages of learning and work

**Advanced Degrees**
- Faculty research
- Postdoctoral fellowships
- Graduate fellowships
- Graduate research assistantships

**Undergraduate (college/university)**
- Curriculum development & faculty development at 2-year and 4-year institutions
- Undergraduate research assistantships
- Experiential learning (research experiences, internships, co-ops)

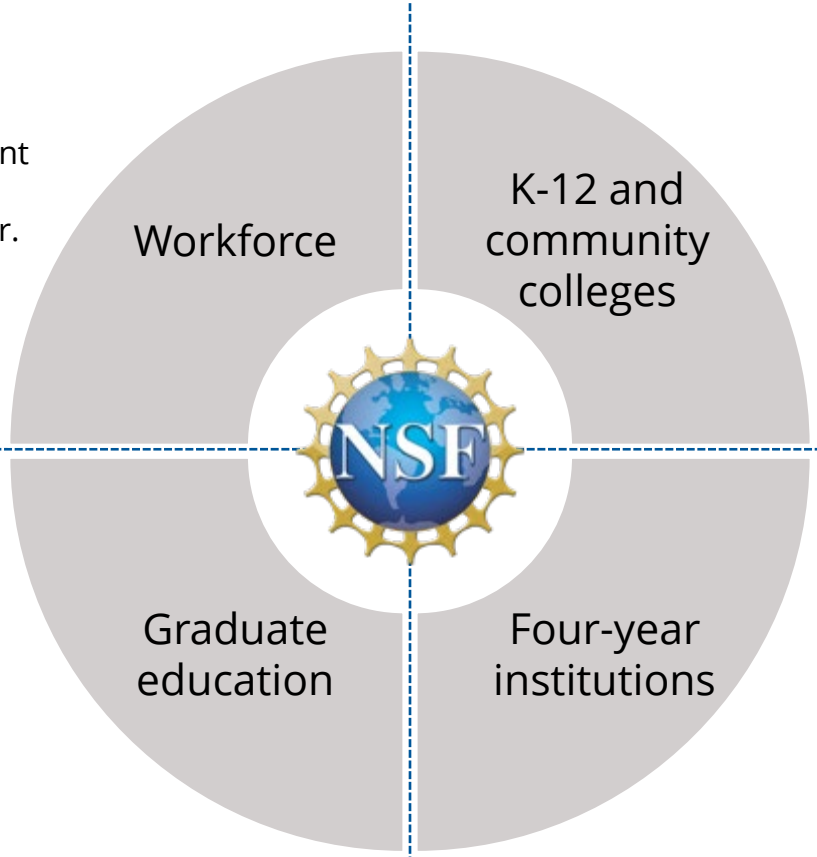


**K-12**
- Curricula, learning activities
- Teacher education & research experiences (in-service teachers)
- Teacher preparation (pre-service teachers)

**Informal Learning and Citizen Science**

# Key NSF workforce development programs

**Experiential Learning in Emerging and Novel Technologies (ExLENT)**
- Invests in practical experiences, including for the current workforce looking to reskill in emerging technologies.
- Anticipated to touch 1,000 students beginning this year.




**Advanced Technological Education (ATE)**
- Invests in advanced technician training.
- Touches nearly 40,000 students, 9,000 teachers annually.

**Non-Academic Research Internships for Graduate Students (INTERN)**
- Invests in internships for NSF-funded graduate students.
- Supports more than 300 students each year.

**CSGrad4US Fellowships, eFellows, and MPS-Ascend**
- Invests in increasing the number and diversity of advanced degree students and post-docs.

**Supplements for Access to Semiconductor Fabrication**
- Provides funding to enable access to semiconductor fabrication for research and education.

**NSF Scholarships in STEM (S-STEM)**
- Invests in low-income students.
- Has touched more than 100,000 students in nearly every state, plus PR and USVI, since 2006.

**Research Experiences for Undergraduates (REU)**
- Supports more than 6,000 students annually to conduct research and receive mentoring.

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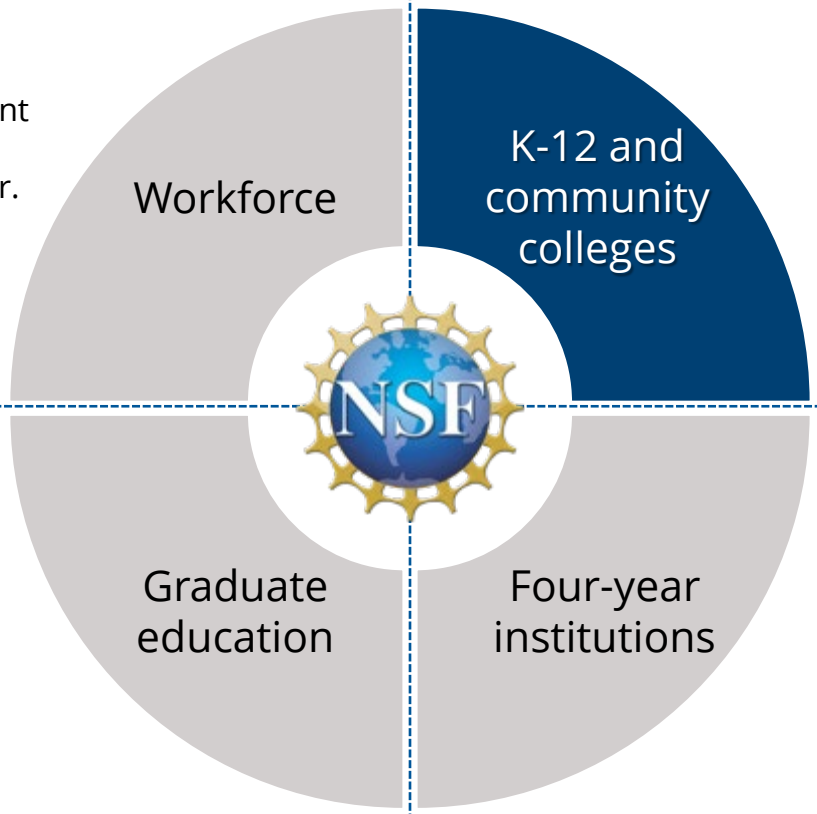


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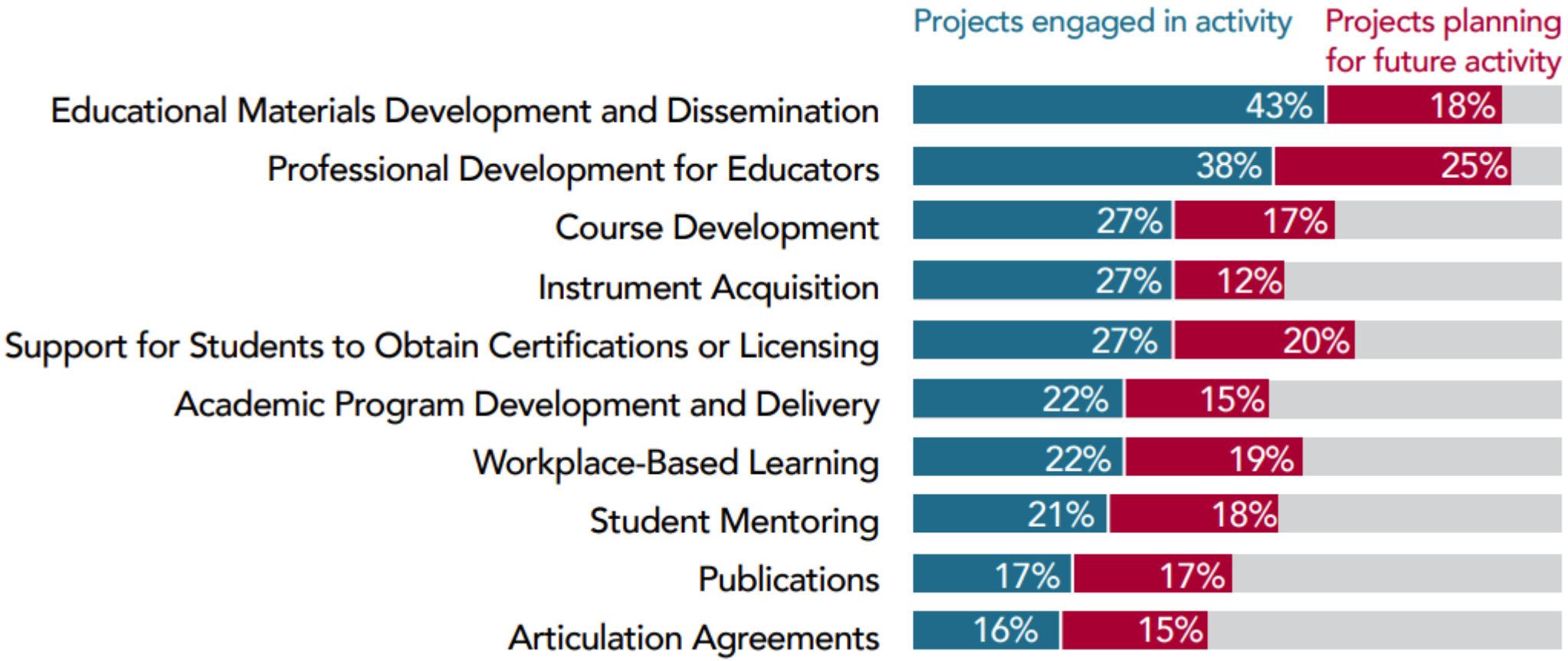
# Advanced Technological Education (ATE) Program

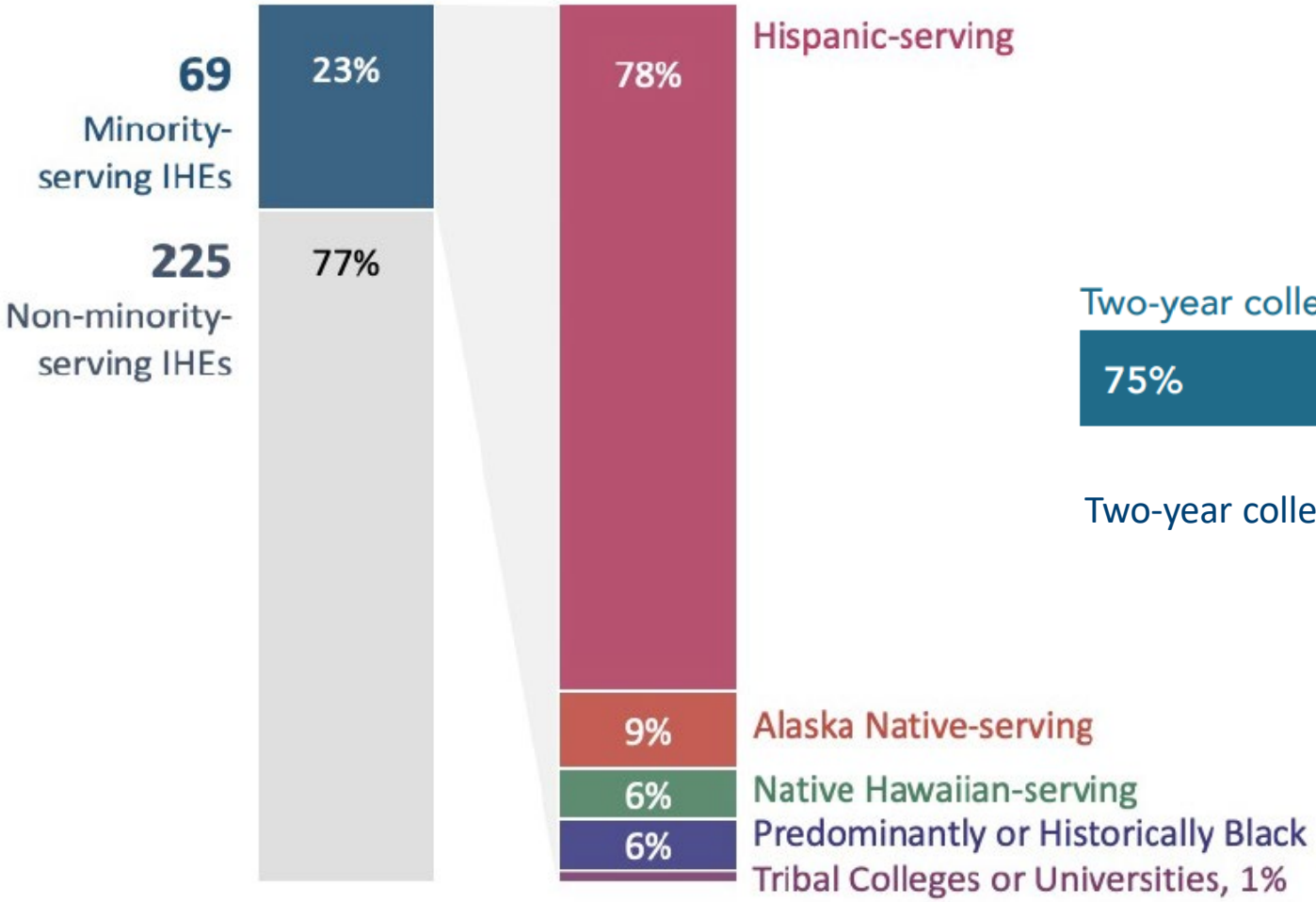
*Supports partnerships between community and technical colleges, four-year colleges/universities, industry, and other entities to improve the education of technicians in science and engineering*

- NSF's major program targeting the *skilled technical workforce* (see https://www.nsf.gov/nsb/NSBActivities/skilled-technical-workforce.jsp)
- Focuses on...
  - Technician education for the high-tech fields that drive the U.S. economy
  - Community and technical colleges (two-year colleges)
  - Associate degree programs and certificate programs
  - Pathways: secondary school (Career & Technical Education) → community college → four-year college/university
  - Partnerships: community colleges, employers, four-year colleges/universities, K-12 schools
- Supports all fields of technology: advanced manufacturing, biotech, chemical tech, environmental tech, IT/cybersecurity, microelectronics, etc.
- Supports *Centers* (large, comprehensive efforts @ ~$500k–$1.5M per year) and *Projects* (smaller, focused efforts @ ~$100k–$200k per year)

# ATE highlights: Grantee activities (FY 2020)



# ATE highlights: Grantee institutions (FY 2020)

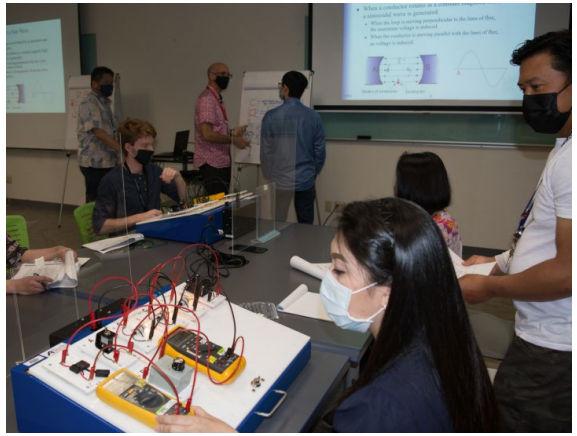




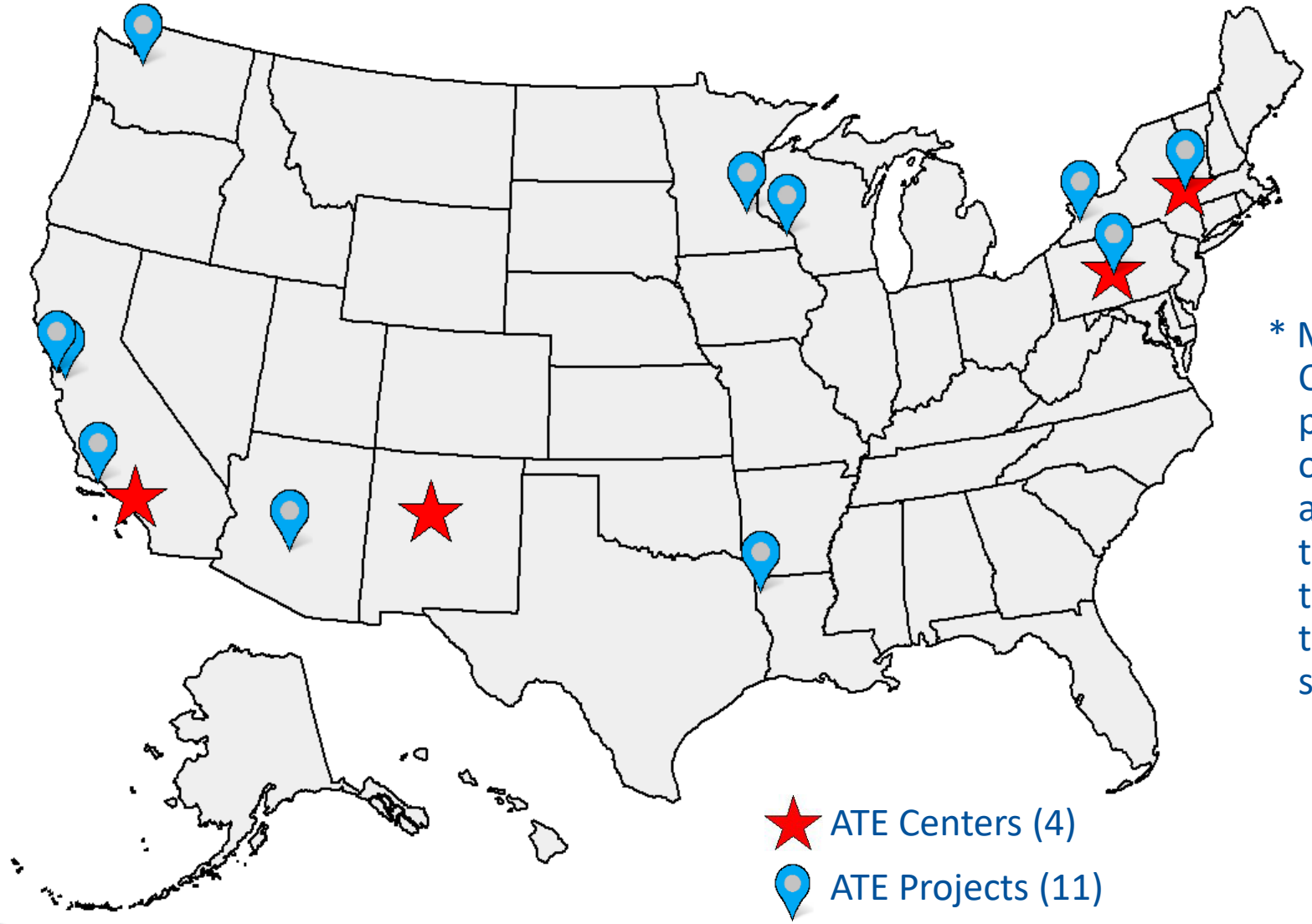
Two-year colleges must have a significant leadership role in *all* ATE projects.

# ATE highlights: Students (FY 2020)

The ATE program served > 39,500 students in 2020

# CHIPS-focused* active ATE awards




* Many awards in *other* (non-CHIPS) categories of the ATE portfolio — e.g., photonics/ optics/laser technology, advanced manufacturing, energy technology, general engineering technology — *also* deal with topics relevant to the semiconductor workforce.

# Key NSF workforce development programs

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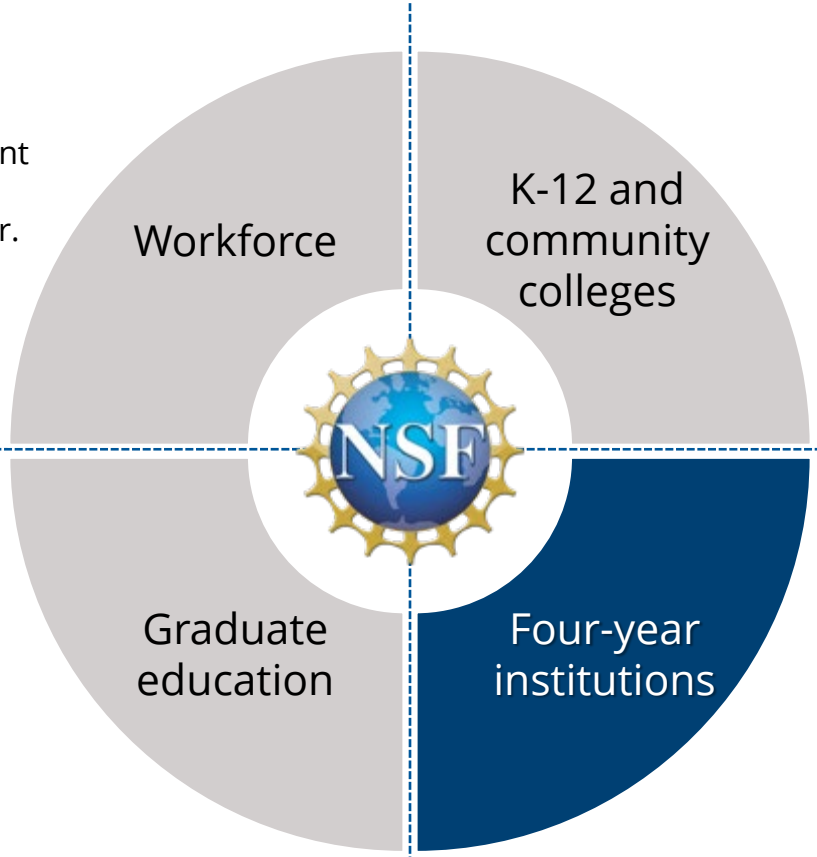


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# NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) Program

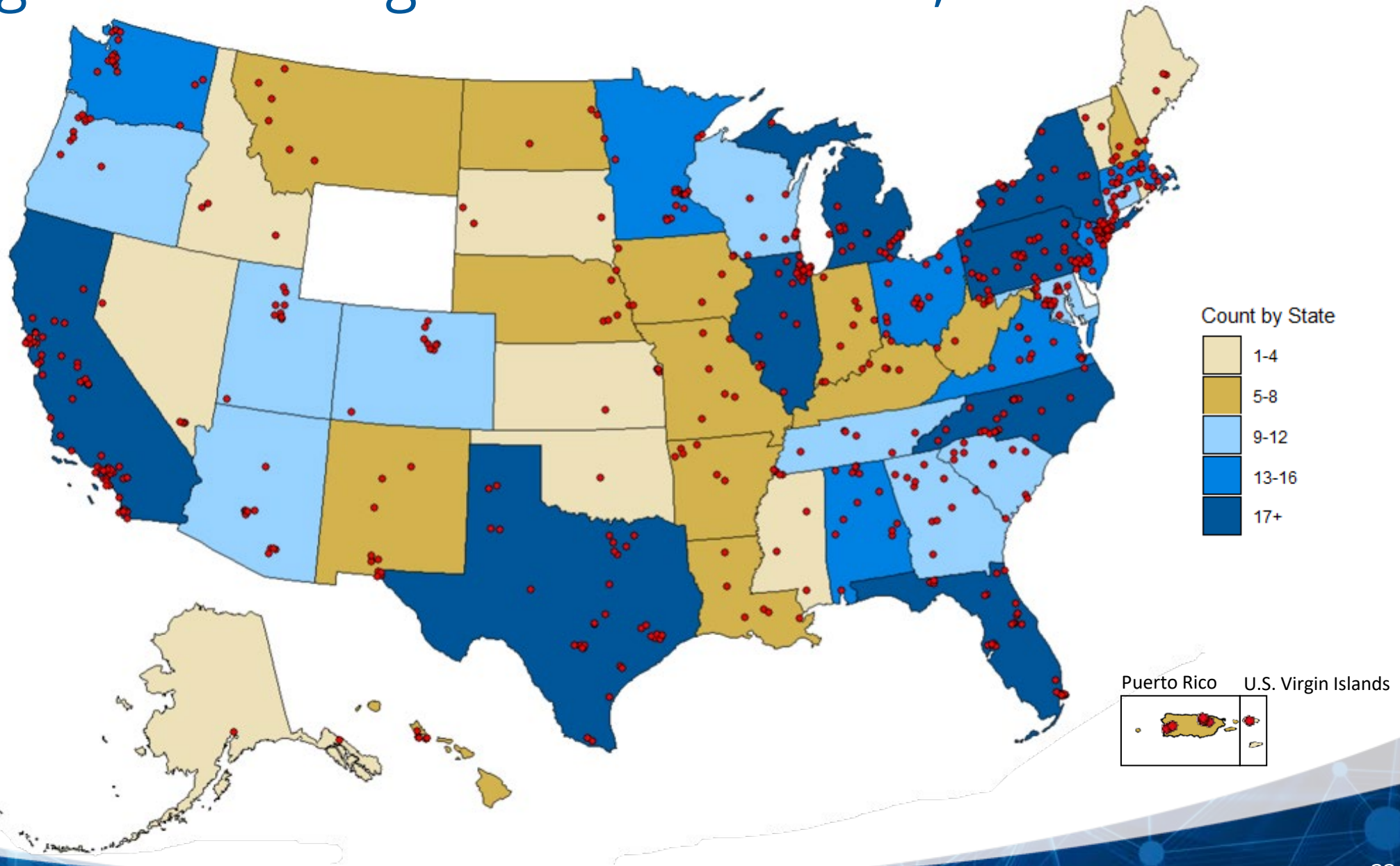
*Provides grants to colleges and universities to fund...*

- *scholarships for low-income, academically talented students in STEM fields*
- *curricular and co-curricular activities that support the recruitment, retention, graduation, and success of the scholarship recipients, and*
- *research on factors that affect the success of low-income students in STEM*

- Goal: Increase the number of low-income, academically talented students who graduate with a STEM degree and contribute to the American innovation economy
- Degree programs may be associate, bachelor's, master's, or doctoral level
- For the scholarships, grantees may target students in specific STEM majors or themes (e.g., physics, cybersecurity, engineering, microelectronics) or students in multiple disciplines
- Since 2006, the program has awarded > 1,600 grants providing > 100,000 scholarships, an investment of $1.4 billion
- Funding for the program comes from the "scholarship and training" fee that U.S. employers pay when they sponsor a foreign worker on an H-1B visa

# S-STEM grants to colleges and universities, FYs 2018–2022

N = 574



# Examples of NSF Partnerships with Semiconductor Companies

## Example #1:

- Goal: Improve the education of skilled technicians in semiconductor manufacturing and design
- Joint investment: $10M
- Co-fund relevant, meritorious proposals submitted to the **ATE** and **S-STEM** programs
- Proposals must leverage strong industry–academic partnerships to strengthen the semiconductor manufacturing workforce
- Proposals may involve scholarships; experiential learning; development or improvement of courses, certificates, and programs; integration of industry standards; and other activities
- The company will engage with funded faculty and students, offering subject matter expertise, seminars, potential internships, etc.

## Example #2:

- Goal:  Design and implement bold, potentially transformative solutions to address semiconductor manufacturing and design challenges and workforce shortages
- Joint investment: $10M
- The company will co-fund proposals for instructional materials development, teacher professional development, and experiential learning opportunities for students at two-year and four-year colleges and universities

# Research Experiences for Undergraduates (REU) Program

*Provides grants to universities and other research organizations to fund college/university students to conduct semi-independent research projects, mentored by senior researchers*

- Encompasses all areas of research normally supported by NSF (including semiconductor/microelectronics research)
- **REU Site**: a cohort of students (typically 8-12) engaged in mentored research projects organized around a discipline or other theme
- ~ 600 REU Sites operate every year at universities, field stations, observatories, museums, and other research facilities around the United States, and some abroad
- ~ 6,000 students participate in REU Sites every year
- Majority of REU Sites operate for 9-10 weeks during the summer
- Students receive a stipend, lodging and meal allowance, and travel allowance

# Students at REU Sites…

- Conduct cutting-edge research with modern equipment/tools in first-rate facilities/settings
- Are mentored by research-active faculty, postdocs, and grad students
- Coauthor articles, prepare posters, and give presentations at student research symposia and regional or national professional meetings
- Participate in group activities: seminars, mini-courses, field trips, etc.
- Develop…
  - deeper knowledge of science and engineering,
  - understanding of the research process and “culture” of the discipline,
  - understanding of career pathways and graduate school in S&E, and
  - writing, communication, and presentation skills

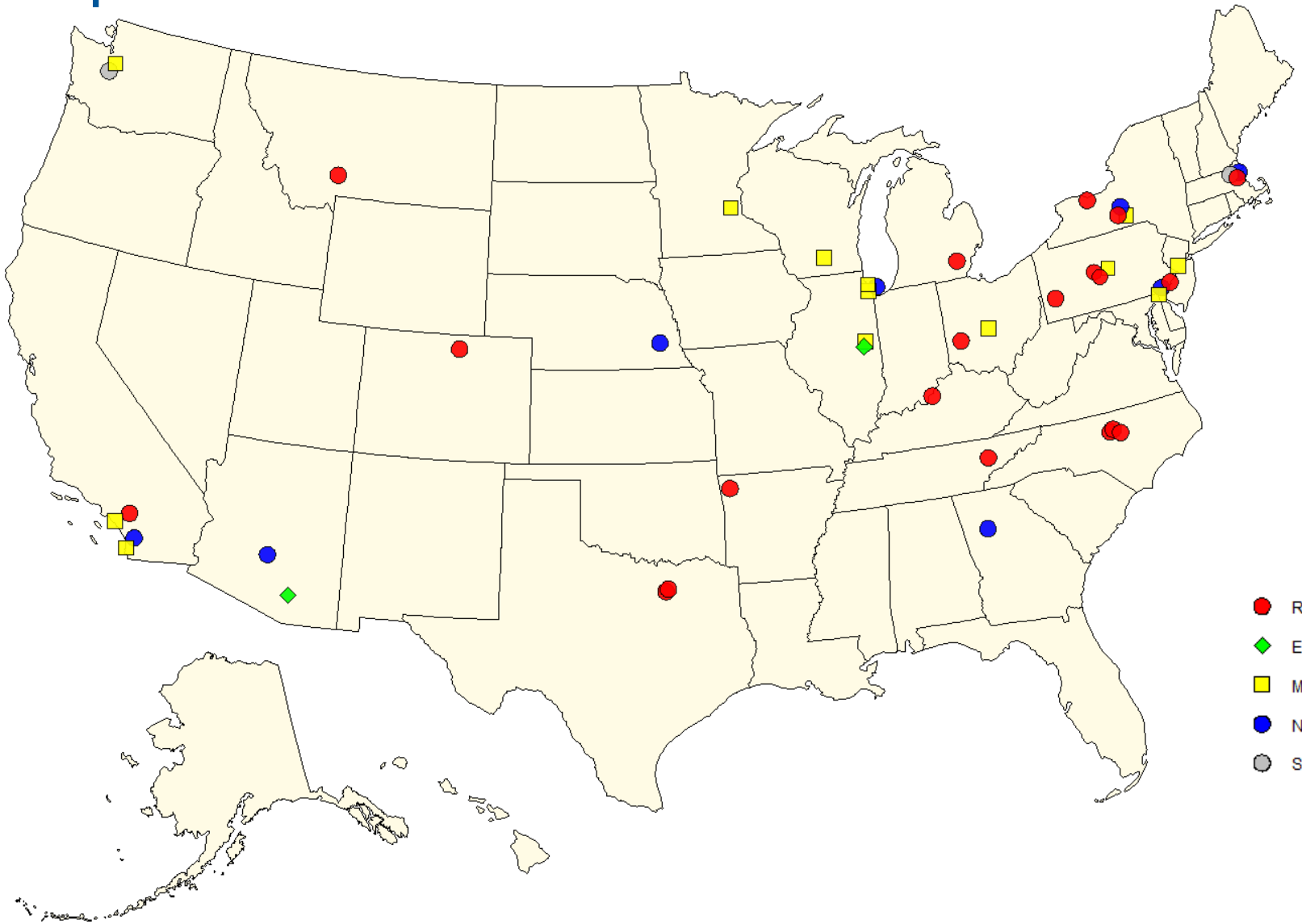
# NSF–SRC partnership

- In 2022, NSF and the **Semiconductor Research Corporation (SRC)** established a partnership to expand undergraduate research opportunities related to advances in semiconductors
- SRC will co-fund **REU Sites** on semiconductor-related topics, selected from the REU Site proposals submitted to NSF's annual competition
- SRC will also share information with REU students and faculty about semiconductor industry career paths, industry perspectives, conferences, etc.

*"I am an NSF REU success story. I was an REU student in Professor Lisa McElwee-White's organometallic chemistry lab, and after a short summer in the program, I was hooked! The experience drove me into graduate studies in chemistry that led to an amazing career in nanotechnology with Intel. Now, I'm thrilled that NSF, SRC, and SRC members can help create similar experiences for the next generation of semiconductor innovators."*

— Dr. Todd Younkin, President & CEO, SRC

# Examples of CHIPS-related* summer REU Sites (45)



* Many *other* REU Sites have research themes *adjacent to* semiconductors and microelectronics (e.g., renewable energy, batteries, lasers and photonics, biomedical engineering).

- Research Experiences for Undergraduates (REU) Site
- Engineering Research Center (ERC)
- Materials Research Science & Engineering Center (MRSEC)
- National Nanotechnology Coordinated Infrastructure (NNCI) Site
- Science & Technology Center (STC)

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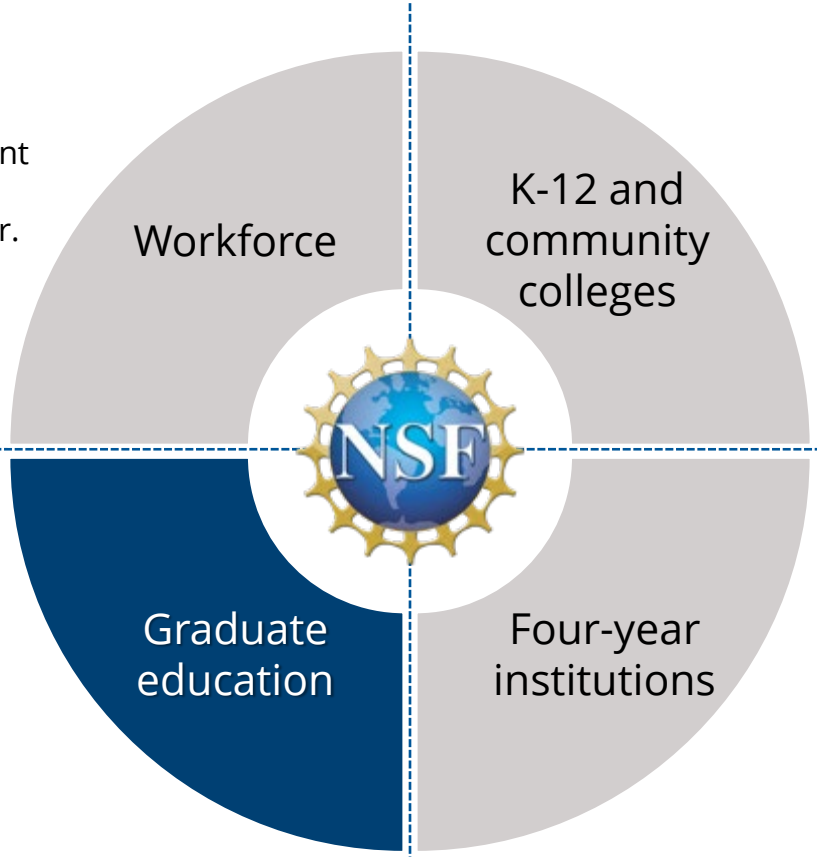


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# Non-Academic Research Internships for Graduate Students (INTERN) Program

*Provides supplemental funding to active NSF awards to support internships for graduate students in non-academic settings*

- Goal: Complement grad students' academic research training and prepare them for a broad range of career paths
- Experience is expected to build knowledge and skills that students need to enter the S&E workforce:
  - Technical knowledge and skills
  - Teamwork
  - Communication (written, oral)
  - Project management
  - Innovation and entrepreneurship
  - Business and economics
- Has funded internships for ~1,400 students in many areas of R&D, including semiconductors and microelectronics, since 2017
- Provides up to $55k per student for up to 6 months of internship, but may be extended
- Expectation is that the internship should not unduly lengthen a student's time-to-degree

## Internship settings:

- Industry labs and R&D groups
- Start-ups and small businesses (including SBIR and STTR grantees)
- National labs
- Museums
- Policy think tanks
- Nonprofits

# Examples of INTERN host organizations

# CSGrad4US Fellowship Program

*Supports graduate study leading to a research-based doctoral degree in computer science, computer engineering, or information science*

- Launched in February 2021
- Goal: Increase the number and diversity of U.S. Citizens, U.S. Permanent Residents, and U.S. Nationals pursuing research-based doctoral degrees in computing fields
- Context: Computing fields are experiencing booming undergraduate enrollments, but few of those students go on to grad school
- Target of fellowships: Bachelor's degree holders returning from industry into PhD programs

**Fellowship Process**

One-year, part-time mentorship program → application and admission to doctoral degree program → three years of fellowship support → graduation with research-based doctoral degree → research leader in academia, industry, or government

# Postdoctoral Fellowship Programs

## eFellows: Engineering

*Provides postdoctoral fellowships to early-career PhDs in engineering fields*

- Launched in summer 2021; administered by the American Society for Engineering Education (ASEE) with funding from NSF
- Intent: Prepare the fellows to become academic leaders and to succeed in future research careers
- Fellows work in university research settings
- Fellowship experience:
  - Hands-on academic research with a faculty advisor
  - Cohort activities: Learning community, peer mentoring, and professional development webinars with guest speakers from industry and academia
- Provides 2 years of support @ $75k per year salary, plus fringe benefits and travel expenses, paid to the fellow's host institution

## MPS-Ascend: Mathematical & Physical Sciences

*Provides postdoctoral fellowships to PhDs who will broaden the participation of underrepresented racial and ethnic minorities in the mathematical sciences, astronomical sciences, chemistry, physics, and materials research*

- Launched in spring 2021
- Intent: Develop a diverse set of future leaders in MPS fields through research experiences that broaden their perspectives and facilitate interdisciplinary interactions
- Fellows work in universities, museums and other nonprofit institutes, government labs, observatories, and other research settings
- Provides up to 3 years of support @ $100k per year, paid directly to the fellow

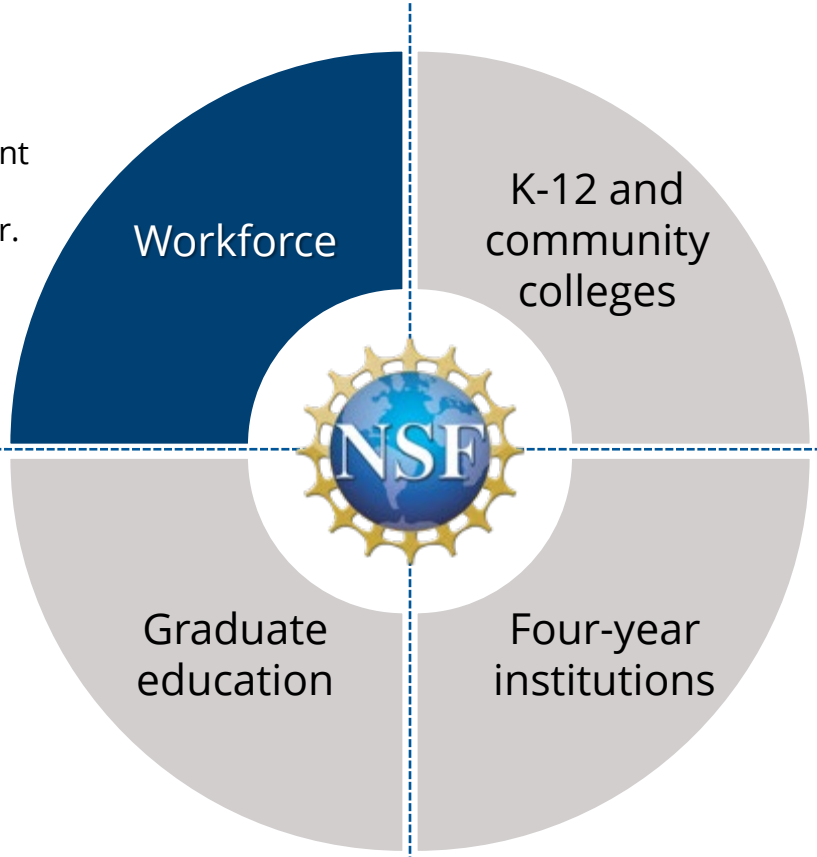
# Supplements for Access to Semiconductor Fabrication (ASF) Program

*Provides supplemental funding to NSF-funded researchers to support their fabrication of semiconductor devices and systems developed in their research projects*

- Context: Design of semiconductor integrated circuits and systems is easier than ever, but fabrication of the designs has become less frequent
- Funds may be requested to access any fabrication facility of the researcher's choice
- Access will also benefit students working on the NSF-funded research projects

# Key NSF workforce development programs

**Experiential Learning in Emerging and Novel Technologies (ExLENT)**
- Invests in practical experiences, including for the current workforce looking to reskill in emerging technologies.
- Anticipated to touch 1,000 students beginning this year.




**Advanced Technological Education (ATE)**
- Invests in advanced technician training.
- Touches nearly 40,000 students, 9,000 teachers annually.

**Non-Academic Research Internships for Graduate Students (INTERN)**
- Invests in internships for NSF-funded graduate students.
- Supports more than 300 students each year.

**CSGrad4US Fellowships, eFellows, and MPS-Ascend**
- Invests in increasing the number and diversity of advanced degree students and post-docs.

**Supplements for Access to Semiconductor Fabrication**
- Provides funding to enable access to semiconductor fabrication for research and education.

**NSF Scholarships in STEM (S-STEM)**
- Invests in low-income students.
- Has touched more than 100,000 students in nearly every state, plus PR and USVI, since 2006.

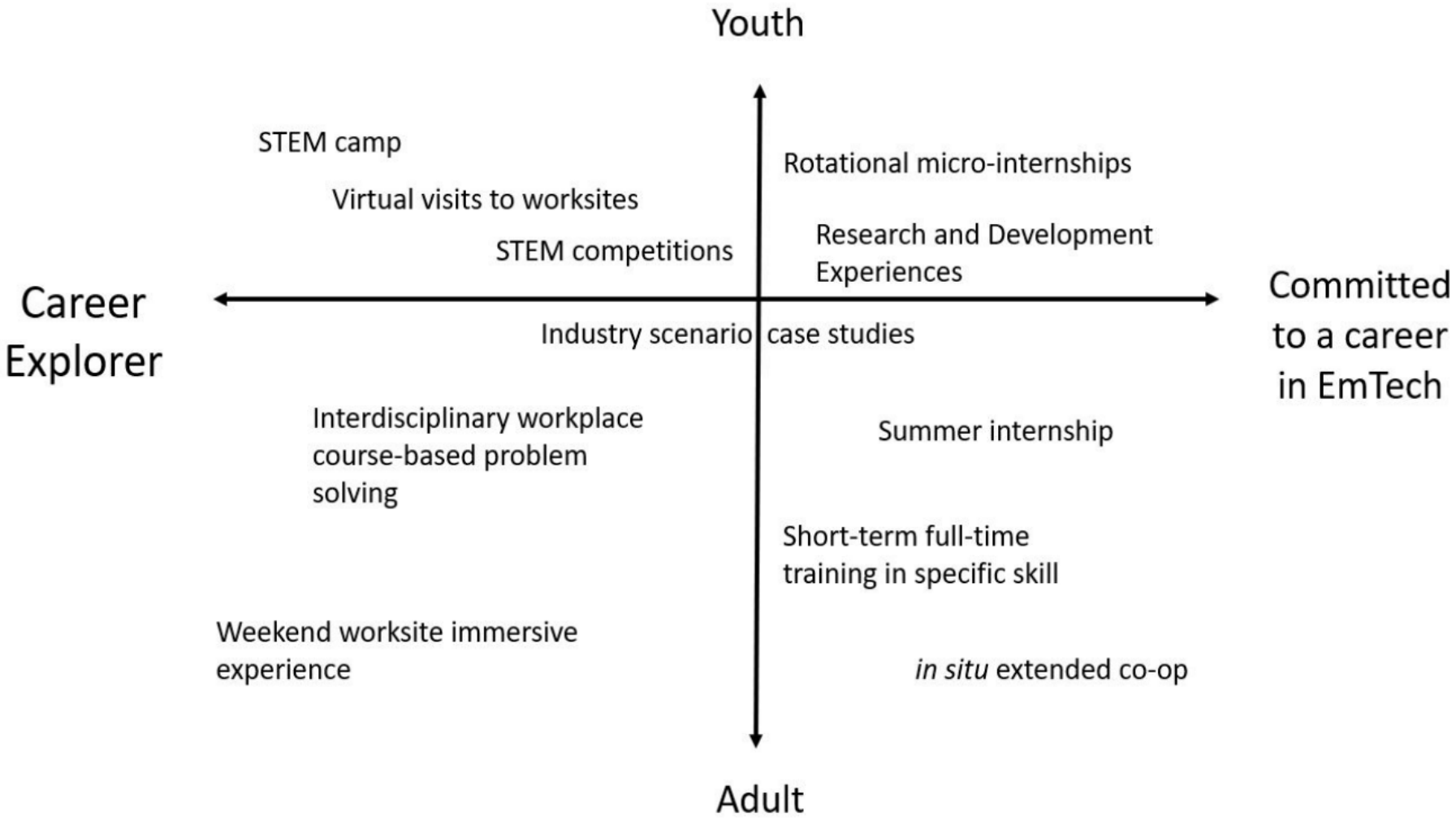
**Research Experiences for Undergraduates (REU)**
- Supports more than 6,000 students annually to conduct research and receive mentoring.

# Experiential Learning for Emerging and Novel Technologies (ExLENT) Program

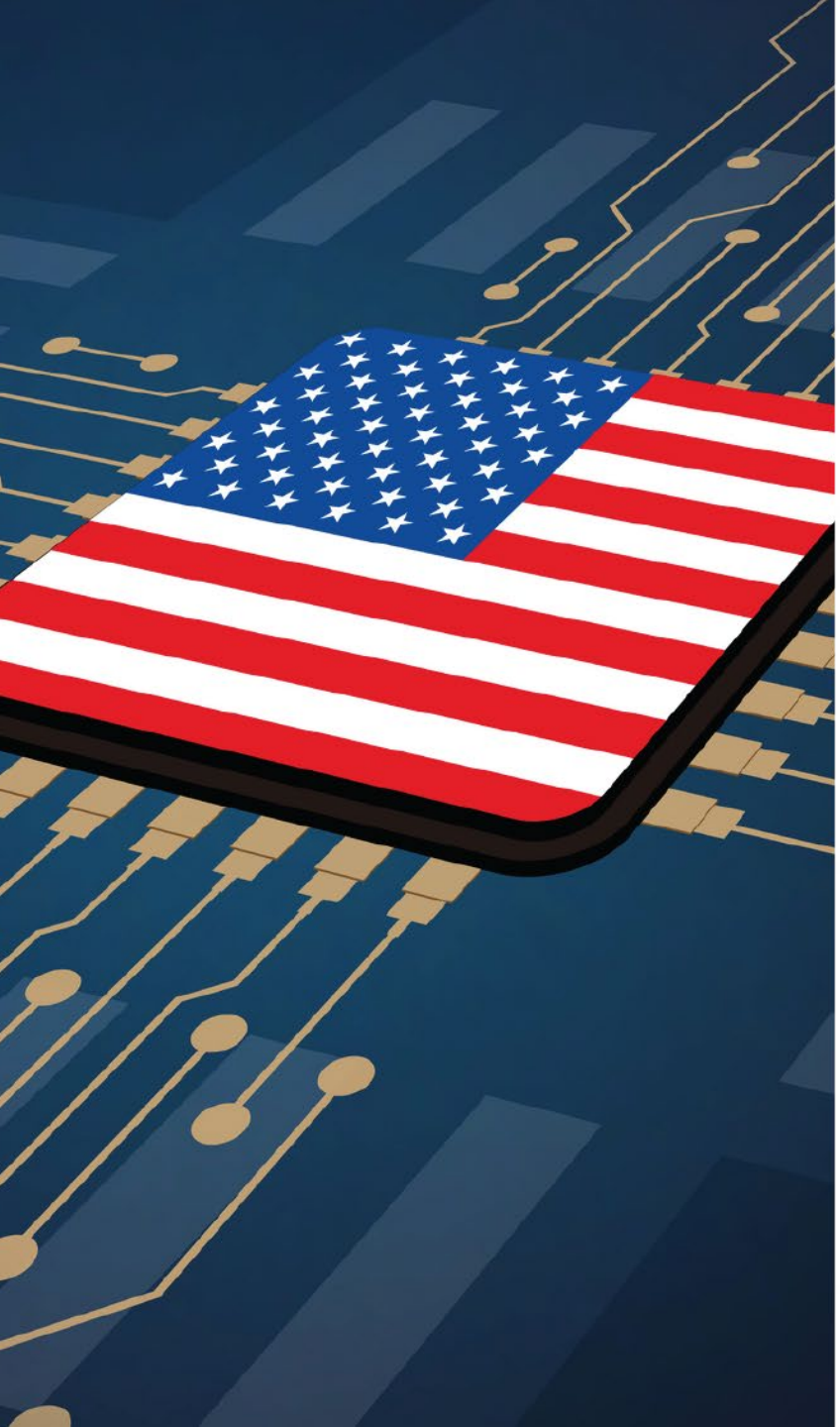
*Supports experiential learning opportunities that provide cohorts of diverse learners with the skills needed to succeed in emerging technology fields*

- New program — first awards anticipated in summer 2023
- Focuses on workforce development for advanced manufacturing, advanced wireless, AI, biotechnology, quantum information science & engineering, semiconductors/microelectronics, etc.
- Goals:
  1. Expand access to career-enhancing experiential learning opportunities for a broad, diverse population, including those who are entering/reentering the workforce and those who are reskilling/upskilling
  2. Promote cross-sector partnerships between organizations with expertise in emerging technology fields and organizations with expertise in workforce development
  3. Develop a workforce aligned with regional economies based on emerging technologies
- Funds experiential learning activities, career exploration, nontraditional educational pathways, mechanisms to overcome barriers that deter individuals from pursuing the fields, etc.

# **ExLENT:** experiential learning activities to serve a broad spectrum of learners



# We welcome your partnership!



# Next Steps

- Explore workforce development opportunities:
  - Partner with NSF or NSF grantees
  - Develop local education and workforce development partnerships
- Visit CHIPS.gov for resources, including:
  - Workforce Development Guide
  - NSTC Strategy and Vision Paper
  - FAQs and fact sheets
- Join CHIPS mailing list
- Contact CHIPS
  - askchips@chips.gov – general inquiries
  - apply@chips.gov – application-related inquiries


# Questions and Answers

# Thank you